Digitized by the Internet Archive
in 2013

http://archive.org/details/resourcebulletin6180paci

3:00. PNW

USDA Forest Service
Resource Bulletin PNW-61

May 1975

CLEMSON UNIVERSITY LIBRARY
SEP 8 1975
SCI., TECH. & AGR. DIV.

1973 WASHINGTON TIMBER HARVEST

by

J. D. Lloyd, Jr., *Supervisory Forester*

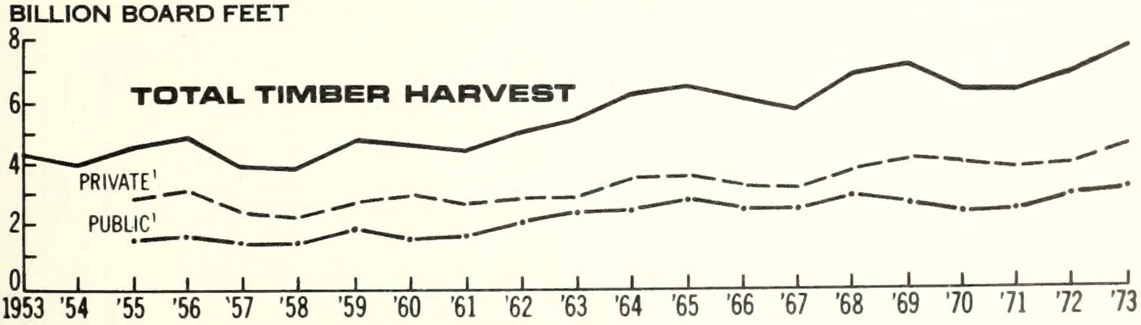
Washington's 1973 timber harvest increased 730 million board feet (10.3 percent) above the 1972 harvest to set a record at 7.81 billion board feet. The previous record set in 1929 was 7.38 billion board feet. Nearly all the increase for the State was in western Washington where the harvest was 700 million board feet (11.9 percent) greater than the previous year.

Almost all the increase was on private lands which showed a gain of 713 million board feet (15.1 percent) over the 1972 harvest. Of this, industrial private increased 176 million board feet (5.5 percent), and the other private sector increased 537 million board feet (64.7 percent)! The increase in harvest on other private lands was 63 million board feet (37.4 percent) in eastern Washington with an even greater increase of 474 million board feet (71.6 percent) in western Washington.

Harvest on all public lands increased only 17 million board feet (0.5 percent). Each of the major public agencies reported a decline compared with the 1972 harvest except National Forests which increased their harvest by 126 million board feet (8.4 percent). This increase was all in western Washington where the National Forest harvest increased 16.7 percent, whereas in eastern Washington the harvest decreased 8.8 percent. The harvest on State-owned lands decreased 0.6 percent, on Indian lands 8.9 percent, and on other public lands 70.6 percent or 44.7 million board feet.

Volume of timber sold on publicly owned or managed lands in 1973 decreased slightly by 21 million board feet (0.9 percent) from the 1972 level. The average stumpage price on these lands increased 90 percent to $62 in eastern Washington and 125 percent to $143 in western Washington.

WASHINGTON TIMBER HARVEST 1953-73



[1] Separate data for public and private not available prior to 1955.

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION

Robert E. Buckman, *Director*
FOREST SERVICE

P.O. Box 3141 , Portland, Oregon 97208
U.S. Department of Agriculture

Timber Harvest by Ownership in the State of Washington, 1973[1]

(In thousand board feet, Scribner log scale)

Half-State and county	Private[2]						State[2]		Bureau of Land Management[4]		National Forests[4]		Indian lands[4]		Other public[2]		Other Federal[2] [5]		Total production
	Industrial		Other		Total private														
	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	
Western Washington:																			
Clallam	140,320	718	56,685	397	197,005	1,115	102,149	576	--	--	75,962	2,429	22,233	--	--	--	--	--	401,469
Clark	13,734	--	25,569	5	39,303	5	8,769	133	--	--	--	--	--	--	210	--	27	--	48,447
Cowlitz	648,201	--	35,077	32	683,278	32	144,234	118	--	--	19,131	821	--	--	--	--	--	--	847,614
Grays Harbor	291,043	66	122,413	929	413,456	995	5,145	256	--	--	72,371	7,844	139,068	218	13,588	59	--	--	653,000
Island	2,019	--	24,125	45	26,144	45	--	--	--	--	--	--	--	--	--	--	500	--	26,689
Jefferson	154,181	540	73,068	1	227,209	541	371,270	3,344	--	--	35,941	2,480	1,969	--	101	--	1,175	--	644,030
King	203,111	--	139,257	--	342,368	--	16,517	133	--	--	92,679	10,397	99	--	180	--	--	--	462,373
Kitsap	5,682	--	33,261	--	38,943	--	2,337	26	--	--	--	--	186	--	--	--	514	--	42,006
Lewis	488,450	--	117,395	377	605,845	377	56,054	258	--	--	104,277	10,637	--	--	143	--	--	15	777,606
Mason	44,911	--	57,955	273	102,866	273	3,724	12	--	--	60,716	39,095	129	--	--	--	--	--	206,815
Pacific	475,860	--	41,103	69	516,963	69	20,710	77	--	--	--	--	--	--	1,573	--	--	--	539,392
Pierce	209,576	--	70,705	--	280,281	--	24,888	1,791	--	--	53,064	1,834	--	--	165	--	--	--	362,023
San Juan	349	--	5,131	--	5,480	--	--	--	--	--	--	--	--	--	--	--	--	--	5,480
Skagit	149,754	--	42,616	2	192,370	2	34,037	35	--	--	81,893	7,208	--	--	208	--	--	--	315,753
Skamania	39,287	--	62,156	28	101,443	28	19,847	26	2	--	328,812	33,213	--	--	--	--	1,195	--	484,566
Snohomish	96,069	48	100,970	70	197,039	118	38,724	1,329	--	--	81,638	15,433	--	--	400	--	--	--	334,681
Thurston	100,688	--	93,894	35	194,582	35	4,832	5	--	--	--	--	--	--	--	--	600	--	200,054
Wahkiakum	98,665	--	12,865	138	111,530	138	15,046	26	--	--	--	--	--	--	602	--	--	--	127,342
Whatcom	44,039	--	19,027	10	63,066	10	12,025	1	--	--	20,945	15,141	--	--	--	--	--	--	111,188
Total	3,205,899	1,372	1,133,272	2,411	4,339,171	3,783	880,308	8,146	2	--	1,027,429	146,532	163,684	218	17,170	59	4,011	15	
Total live and dead	3,207,271		1,135,683		4,342,954		888,454		2		1,173,961		163,902		17,229		4,026		6,590,528
Eastern Washington:																			
Adams	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Asotin	700	--	3,682	121	4,382	121	--	--	--	--	2,012	25	--	--	--	--	--	--	6,540
Benton	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chelan	14,877	--	1,017	--	15,894	--	2,212	--	--	--	55,093	46,535	--	--	--	--	--	--	119,734
Columbia	1,330	605	1,589	--	2,919	605	--	--	--	--	6,209	127	--	--	--	--	--	--	9,860
Douglas	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ferry	6,377	--	6,613	--	12,990	--	8,427	--	--	--	37,093	--	94,962	237	--	--	--	--	153,709
Franklin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Garfield	82	--	469	--	551	--	--	--	--	--	5,745	616	--	--	--	--	--	--	6,912
Grant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Kittitas	76,512	--	43,791	625	120,303	625	10,324	47	--	--	55,166	1,116	--	--	600	660	--	--	188,841
Klickitat	25,604	--	13,152	400	38,756	400	29,883	65	--	--	1,706	90	10,161	2,031	--	--	--	--	83,092
Lincoln	--	--	8,977	--	8,977	--	113	--	--	--	--	--	--	--	--	--	--	--	9,090
Okanogan	4,989	--	18,533	--	23,522	--	26,740	4	258	--	100,555	760	22,190	65	--	--	--	--	174,094
Pend Oreille	5,683	--	37,408	--	43,091	--	6,001	10	--	--	41,120	--	--	--	40	--	873	--	91,135
Spokane	3,818	--	32,028	--	35,846	--	219	15	--	--	--	--	--	--	15	--	--	--	36,095
Stevens	7,509	251	53,382	--	60,891	251	17,751	103	510	--	9,633	--	23,175	--	25	--	738	--	113,077
Walla Walla	4,103	--	1,290	83	5,393	83	--	--	--	--	--	--	--	--	--	--	--	--	5,476
Whitman	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Yakima	1,068	100	8,119	290	9,187	390	7,667	--	--	--	72,320	3,249	115,522	12,878	--	--	--	--	221,213
Total	152,652	956	230,050	1,519	382,702	2,475	109,337	244	768	--	386,652	52,518	266,010	15,211	680	660	1,611	--	
Total live and dead	153,608		231,569		385,177		109,581		768		439,170		281,221		1,340		1,611		1,218,868
Total Washington	3,358,551	2,328	1,363,322	3,930	4,721,873	6,258	989,645	8,390	770		1,414,081	199,050	429,694	15,429	17,850	719	5,622	15	
Total live and dead	3,360,879		1,367,252		4,728,131		998,035		770		1,613,131		445,123		18,569		5,637		7,809,396

---

[1] Includes volume in logs, poles, piling, shingles, bolts, etc.

[2] Compiled by Washington State Department of Natural Resources.

[3] Includes snags and down material existing prior to initial logging.

[4] Compiled by respective agencies, U.S. Bureau of Land Management, U.S. Forest Service, U.S. Bureau of Indian Affairs.

[5] Includes lands logged under jurisdiction of U.S. Department of Interior--Bonneville Power Administration, National Park Service, Bureau of Sport Fisheries and Wildlife; and Department of the Army.

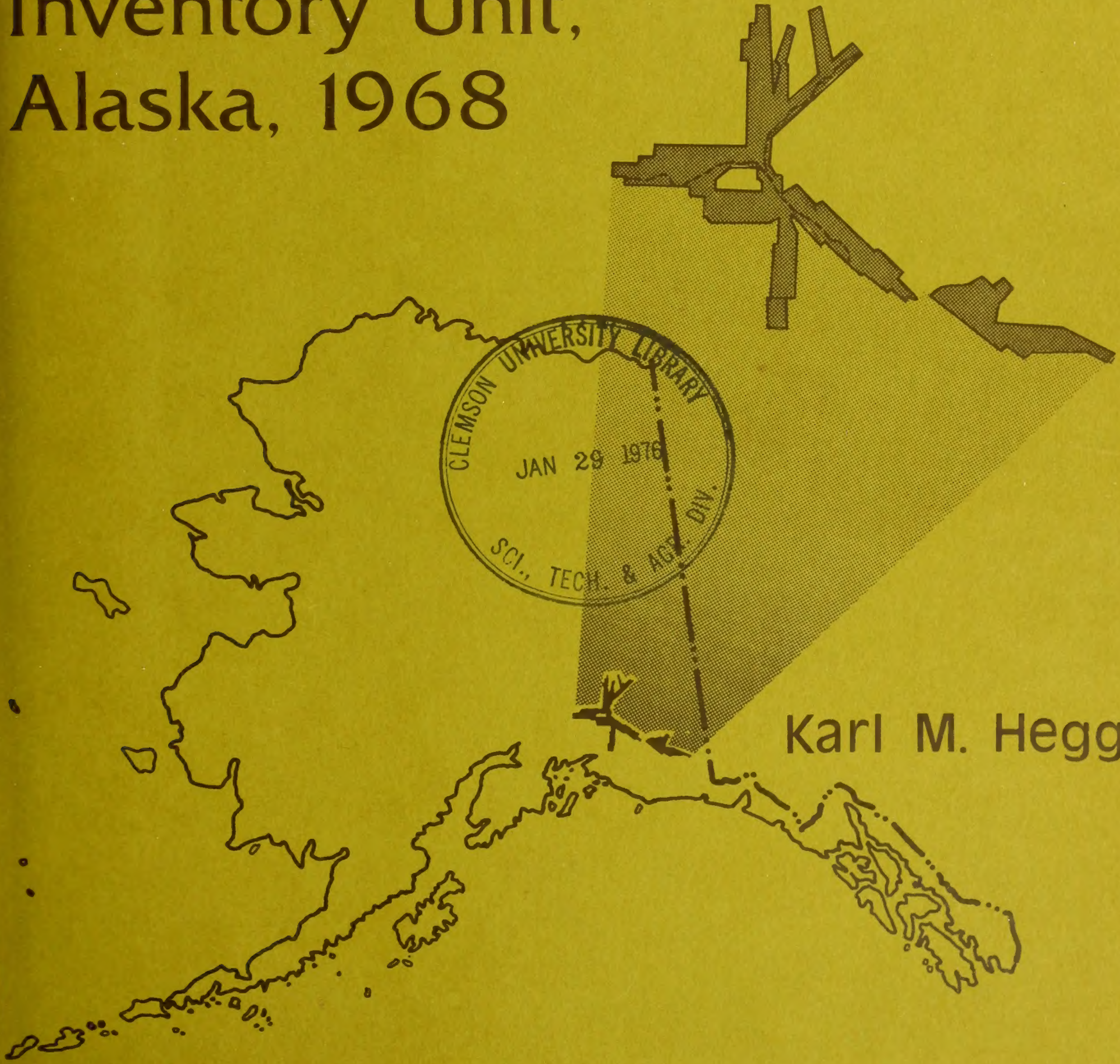
Prepared by Forest Survey Project, Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Portland, Oregon.

Keywords: Production statistics, Washington.

A13.80:PNW-62

1975
USDA FOREST SERVICE RESOURCE BULLETIN PNW-62

TIMBER RESOURCE STATISTICS for the Copper River Inventory Unit, Alaska, 1968



CLEMSON UNIVERSITY LIBRARY
JAN 29 1976
SCI., TECH. & AGR. DIV.

Karl M. Hegg

PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
PORTLAND, OREGON

Prepared by
Alaska Forest Survey Project
Juneau, Alaska

O. Keith Hutchison, Project Leader
Karl M. Hegg, Interior Alaska Supervisor
Ronald M. Dippold, Photo Interpretation and Field Supervisor

Field crew:

Forest Survey Project	Bureau of Land Management	Alaska Division of Lands
Karl M. Hegg	Harold Johnson	Enzo Becia
Ronald M. Dippold	Robert Sorenson	
Dennis Murphy	Chuck Holmes	
	Walt Brunner	

Office compilation:

John M. Berger, Supervisor (Portland)

The successful completion of this study was made possible through the generous assistance of the Bureau of Land Management of the U.S. Department of the Interior and the Alaska Division of Lands of the State of Alaska in providing personnel, funds, and transportation.

CONTENTS

Page

METRIC CONVERSIONS v

RESEARCH SUMMARY vii

HIGHLIGHTS viii

INTRODUCTION 1

OBSERVATIONS 1
- Area and Location 1
- Forest Description. 3
- Forest Use. 4
- Defect. 5
- Regeneration. 5

SURVEY METHODS 6

SAMPLING ERROR 6

PRINCIPAL TREE SPECIES OF ALASKA 7

TERMINOLOGY. 7

LITERATURE CITED 55

TABLES

COPPER RIVER INVENTORY UNIT

1. Area by productivity and land class, Copper River inventory unit, Alaska, 1968. 14
2. Area of commercial and operable noncommercial forest land, by stand-size class, Copper River inventory unit, Alaska, 1968 14
3. Area of commercial and operable noncommercial forest land, by stand-volume class, Copper River inventory unit, Alaska, 1968 . . . 15
4. Area of commercial and operable noncommercial forest land, by stand-volume and stand-size classes, Copper River inventory unit, Alaska, 1968. 15
5. Area of commercial forest land by area condition class, Copper River inventory unit, Alaska, 1968. 16
6. Area of commercial forest land, by site class, Copper River inventory unit, Alaska, 1968. 17
7. Area of commercial and noncommercial forest land, by forest type, Copper River inventory unit, Alaska, 1968 17
8. Area of commercial forest land, by stand age and stand-size class, Copper River inventory unit, Alaska, 1968 18
9. Area of operable noncommercial forest land, by stand age and stand-size class, Copper River inventory unit, Alaska, 1968 19
10. Number of growing-stock trees on commercial forest land, by diameter class and species, Copper River inventory unit, Alaska, 1968. 19
11. Number of growing-stock trees 5.0-inch d.b.h. and larger on commercial and operable noncommercial forest land, by height class and species, Copper River inventory unit, Alaska, 1968. . . . 20

Page

12. Net volume of timber on commercial and operable noncommercial forest land, by class of timber and softwoods and hardwoods, Copper River inventory unit, Alaska, 1968. 21
13. Net volume of growing stock on commercial forest land, by species and diameter class, Copper River inventory unit, Alaska, 1968. . . . 22
14. Net volume of growing stock on commercial and operable noncommercial forest land, by species and diameter class, Copper River inventory unit, Alaska, 1968 22
15. Net volume of sawtimber on commercial forest land, by species and diameter class, Copper River inventory unit, Alaska, 1968. . . . 23
16. Net volume of sawtimber on commercial and operable noncommercial forest land, by species and diameter class, Copper River inventory unit, Alaska, 1968 23
17. Gross volume of sawtimber on commercial forest land, by species and diameter class, Copper River inventory unit, Alaska, 1968. . . . 24
18. Gross volume of sawtimber on commercial and operable noncommercial forest land, by species and diameter class, Copper River inventory unit, Alaska, 1968 24
19. Net volume of growing stock on commercial forest land by forest type and softwoods and hardwoods, Copper River inventory unit, Alaska, 1968 25
20. Net volume of growing stock on operable noncommercial forest land by forest type and softwoods and hardwoods, Copper River inventory unit, Alaska, 1968 25
21. Net volume of sawtimber on commercial forest land by forest type and softwoods and hardwoods, Copper River inventory unit, Alaska, 1968 25
22. Net volume of sawtimber on operable noncommercial forest land by forest type and softwoods and hardwoods, Copper River inventory unit, Alaska, 1968 26
23. Net volume of sawtimber on commercial forest land, by species and log grade, Copper River inventory unit, Alaska, 1968 26
24. Net volume of sawtimber on operable noncommercial forest land, by species and log grade, Copper River inventory unit, Alaska, 1968 . . 27
25. Net annual growth of growing stock , by species and forest-land class, Copper River inventory unit, Alaska, 1968 28
26. Net annual growth of sawtimber, by species and forest-land class, Copper River inventory unit, Alaska, 1968. 28
27. Annual mortality of growing stock, by species and forest-land class, Copper River inventory unit, Alaska, 1968 29
28. Annual mortality of sawtimber, by species and forest-land class, Copper River inventory unit, Alaska, 1968. 29
29. Annual mortality of growing stock on commercial and noncommercial forest land, by cause and by softwoods and hardwoods, Copper River inventory unit, Alaska, 1968 30
30. Annual mortality of sawtimber on commercial and noncommercial forest land, by cause and by softwoods and hardwoods, Copper River inventory unit, Alaska, 1968 30

GULKANA BLOCK

31. Area by productivity and land class, Gulkana block, Copper River inventory unit, Alaska, 1968 32

Page

32. Area of commercial and operable noncommercial forest land, by stand-size class, Gulkana block, Copper River inventory unit, Alaska, 1968. 32
33. Area of commercial forest land by area condition class, Gulkana block, Copper River inventory unit, Alaska, 1968. 33
34. Area of commercial and noncommercial forest land, by forest type, Gulkana block, Copper River inventory unit, Alaska, 1968. 34
35. Net volume of timber on commercial and operable noncommercial forest land, by class of timber and softwoods and hardwoods, Gulkana block, Copper River inventory unit, Alaska, 1968 35
36. Net volume of growing stock on commercial forest land by forest type and softwoods and hardwoods, Gulkana block, Copper River inventory unit, Alaska, 1968. 35
37. Net volume of growing stock on operable noncommercial forest land by forest type and softwoods and hardwoods, Gulkana block, Copper River inventory unit, Alaska, 1968 36
38. Net volume of sawtimber on commercial forest land by forest type and softwoods and hardwoods, Gulkana block, Copper River inventory unit, Alaska, 1968. 36
39. Net volume of sawtimber on operable noncommercial forest land by forest type and softwoods and hardwoods, Gulkana block, Copper River inventory unit, Alaska, 1968. 37
40. Net volume of sawtimber on commercial forest land, by species and log grade, Gulkana block, Copper River inventory unit, Alaska, 1968 . 37
41. Net volume of sawtimber on operable noncommercial forest land, by species and log grade, Gulkana block, Copper River inventory unit, Alaska, 1968. 38

KLUTINA BLOCK

42. Area by productivity and land class, Klutina block, Copper River inventory unit, Alaska, 1968. 40
43. Area of commercial and operable noncommercial forest land, by stand-size class, Klutina block, Copper River inventory unit, Alaska, 1968. 40
44. Area of commercial forest land by area condition class, Klutina block, Copper River inventory unit, Alaska, 1968. 41
45. Area of commercial and noncommercial forest land, by forest type, Klutina block, Copper River inventory unit, Alaska, 1968 42
46. Net volume of timber on commercial and operable noncommercial forest land, by class of timber and softwoods and hardwoods, Klutina block, Copper River inventory unit, Alaska, 1968. 43
47. Net volume of growing stock on commercial forest land by forest type and softwoods and hardwoods, Klutina block, Copper River inventory unit, Alaska, 1968. 43
48. Net volume of growing stock on operable noncommercial forest land by forest type and softwoods and hardwoods, Klutina block, Copper River inventory unit, Alaska, 1968 44
49. Net volume of sawtimber on commercial forest land by forest type and softwoods and hardwoods, Klutina block, Copper River inventory unit, Alaska, 1968. 44
50. Net volume of sawtimber on operable noncommercial forest land by forest type and softwoods and hardwoods, Klutina block, Copper River inventory unit, Alaska, 1968. 45

Page

51. Net volume of sawtimber on commercial forest land, by species and log grade, Klutina block, Copper River inventory unit, Alaska, 1968. 45
52. Net volume of sawtimber on operable noncommercial forest land, by species and log grade, Klutina block, Copper River inventory unit, Alaska, 1968. 46

WRANGELL BLOCK

53. Area by productivity and land class, Wrangell block, Copper River inventory unit, Alaska, 1968. 48
54. Area of commercial and operable noncommercial forest land, by stand-size class, Wrangell block, Copper River inventory unit, Alaska, 1968. 48
55. Area of commercial forest land by area condition class, Wrangell block, Copper River inventory unit, Alaska, 1968. 49
56. Area of commercial and noncommercial forest land, by forest type, Wrangell block, Copper River inventory unit, Alaska, 1968 50
57. Net volume of timber on commercial and operable noncommercial forest land, by class of timber and softwoods and hardwoods, Wrangell block, Copper River inventory unit, Alaska, 1968 51
58. Net volume of growing stock on commercial forest land by forest type and softwoods and hardwoods, Wrangell block, Copper River inventory unit, Alaska, 1968. 51
59. Net volume of growing stock on operable noncommercial forest land by forest type and softwoods and hardwoods, Wrangell block, Copper River inventory unit, Alaska, 1968 52
60. Net volume of sawtimber on commercial forest land by forest type and softwoods and hardwoods, Wrangell block, Copper River inventory unit, Alaska, 1968. 52
61. Net volume of sawtimber on operable noncommercial forest land by forest type and softwoods and hardwoods, Wrangell block, Copper River inventory unit, Alaska, 1968. 53
62. Net volume of sawtimber on commercial forest land, by species and log grade, Wrangell block, Copper River inventory unit, Alaska, 1968. 53
63. Net volume of sawtimber on operable noncommercial forest land, by species and log grade, Wrangell block, Copper River inventory unit, Alaska, 1968. 54

METRIC CONVERSIONS

1 acre = 0.4047 hectare
1 hectare = 2.47 acres
1 cubic foot = 0.0283 cubic meter
1 cubic meter = 35.3145 cubic feet
1 cubic foot per acre = 0.06997 cubic meter per hectare
1 cubic meter per hectare = 14.29 cubic feet per acre
20 cubic feet per acre = 1.3994 cubic meter per hectare
1 square foot basal area per acre = 0.2296 square meter per hectare
1 square meter per hectare = 4.356 square feet per acre

TIMBER RESOURCE STATISTICS FOR THE COPPER RIVER INVENTORY UNIT, ALASKA, 1968

Reference Abstract

Hegg, Karl M.
1975. Timber resource statistics for the Copper River inventory unit, Alaska, 1968. USDA For. Serv. Resour. Bull. PNW-62, 55 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This first intensive forest inventory of Alaska's Copper River Valley found a commercial forest area of 287,800 acres with 303.8 million cubic feet of growing stock. Additionally, a noncommercial stratum was examined that had substantial standing volume but did not meet the growth criteria for commercial forest land. This stratum contained 152,800 acres with a volume of 157.9 million cubic feet. Because of the distance from population centers and the general low quality of the timber, the Copper River stands probably would be marginal suppliers to the world market.

KEYWORDS: Forest surveys (interior Alaska), resources (forest).

RESEARCH SUMMARY
Resource Bulletin PNW–62
1975

The forest inventory of the Copper River inventory unit was a joint effort of the Forest Service, U.S. Department of Agriculture, and the Bureau of Land Management, U.S. Department of the Interior, to gather data for the National Forest Survey and for management planning. Preliminary delineations of potential commercial forest areas were made on small-scale photographs of the entire valley and resource-scale (1:15,840) photographs acquired for the delineated areas. Approximately 16.4 million acres were studied and 2.0 million acres outlined for inventory.

Field inventory work was accomplished the summer of 1968 and data processing completed the spring of 1971. Final inventory results show a commercial forest land area of 287,800 acres with 303.8 million cubic feet of growing stock and a board-foot volume of 1,159.6 million feet. Statistical data are presented for the entire inventory unit and by three management blocks, the Gulkana, Klutina, and Wrangell. These data should not be used as a basis for an allowable cut without consideration of possible management and land use alternatives. By volume and forest type, white spruce is the major commercial component. The commercial forests are concentrated adjacent to river drainages, and this dispersed lineal-type distribution makes a large-scale harvest economically questionable. The white spruce species in the area have an open-grown appearance, and this limbiness restricts their commercial potential. These factors, combined with the scenic backdrop of the mountains surrounding the entire Copper River Valley, lead to the conclusion that recreation may be the best use of the area.

HIGHLIGHTS

	Thousand acres	Thousand hectares
Total Copper River inventory unit area:	2,022.5	818.5
with forests on	1,631.9	660.4
with nonforest on	234.0	94.7
with noncensus water on	44.8	18.1
with census water on	111.8	45.3
Forested areas:		
commercial forest land	287.8	116.5
noncommercial forest land		
more than 800 cubic feet per acre	152.8	61.8
less than 800 cubic feet per acre	1,191.3	482.1
Commercial forest stand-size composition:		
Sawtimber	153.9	62.3
Poletimber	33.1	13.4
Seedling-sapling	93.1	37.7
Nonstocked	7.7	3.1
Commercial forest type composition:		
Balsam poplar	22.5	9.1
Nonstocked	7.7	3.1
Quaking aspen	38.5	15.6
White spruce	219.1	88.7

Inventory unit volumes	Thousand cubic feet[1]	Thousand cubic meters[1]	Thousand board feet[2]	Thousand cubic meters[3]
Total gross volume	315,054.7	8,916.0	1,199,491.8	5,948.0
Total net volume	303,845.9	8,598.8	1,159,587.1	5,735.5
Annual net growth	4,250.5	120.3	23,141.3	48.5
Annual net mortality	314.3	8.9	1,610.4	7.4

---

[1] Volume of roundwood in live trees 5.0-inch d.b.h. and larger.

[2] Net volume, International 1/4-inch rule.

[3] Volume of roundwood in softwood trees 9.0-inch d.b.h. and larger and hardwood trees 11.0-inch d.b.h. and larger.

INTRODUCTION

This resource bulletin reports on the findings of the first intensive inventory of lands with commercial forest potential within the Copper River Valley drainage system. This drainage system totals 16.4 million acres of which slightly more than 2 million acres were included in the inventory unit. We believe we have included nearly all of this drainage system's potential commercial forest land in the 2-million-acre inventory unit.

Since completion of this inventory, many changes have occurred that stress the importance of the area. Of immediate impact, a large section of the trans-Alaska pipeline will pass through the area and will require considerable right-of-way clearing. Perhaps longer lasting effects will come from the Alaska Native Claims Settlement Act (ANCSA). Under terms of this act, almost the entire Copper River Valley will move out of Bureau of Land Management (BLM) stewardship into Native village and Regional selections or into proposed National Forests, parks, refuges, and wild and scenic rivers.

Since this work was begun well before any of these occurrences, data in this report do not reflect these proposed new ownerships but is presented for the total inventory unit and for BLM management blocks of Gulkana, Klutina, and Wrangell. The actual work on this project began in 1966 with acquisition of aerial photographs taken by BLM. At the request of the Forestry Sciences Laboratory (Juneau) of the Pacific Northwest Forest and Range Experiment Station (PNW), additional aerial photographs were taken in 1967 to obtain nearly complete coverage of the potential commercial forest land in the valley. Preliminary field studies were made in the fall of 1967 to obtain photo interpretation guidelines and to provide training for interpreters. A cooperative effort by the BLM and the Forestry Sciences Laboratory completed the photo interpretation and fieldwork in 1967-68. Data processing was handled by the PNW Station at Portland.

Forest Survey, authorized by the McSweeney-McNary Act in 1928 and extended by amendment to Alaska in 1954, is a nationwide effort conducted at various locations to obtain information on forest lands--their extent, condition, volume, growth, and depletion. The first extensive forest inventories of interior Alaska were begun in 1956 and completed in 1962. This inventory is reported in USDA Forest Service Resource Bulletin PNW-19 (Hutchison 1967). Forest Survey has subsequently defined areas with commercial forest concentrations for which more intensive inventories are desirable. In addition to the Copper River inventory unit, other areas that have been more intensively inventoried and for which reports are available or pending are: Susitna Valley (Hegg 1970), Kuskokwim River, upper Koyukuk River (Hegg 1974), Tuxedni Bay, Norton Bay Indian Reservation, and the Kantishna, Fairbanks (Hegg 1975), upper Tanana, and Wood-Salcha blocks of the Tanana unit.

The factual data and discussions in this report on forest area, location and condition, volume growth, and regeneration relate to the supply of wood available for local, regional, and national needs. These data are presented for use of State planners, legislators, land and forest managers, forest industry, and other forest inventory data users.

OBSERVATIONS

Area and Location

The Copper River inventory unit is located in south-central Alaska about 150 to 200 miles east of Anchorage (fig. 1). Geographically this unit lies between 141°31' to 147°10' West longitude and 61°00' to 62°45' North latitude. The entire valley is at about 1,000-foot

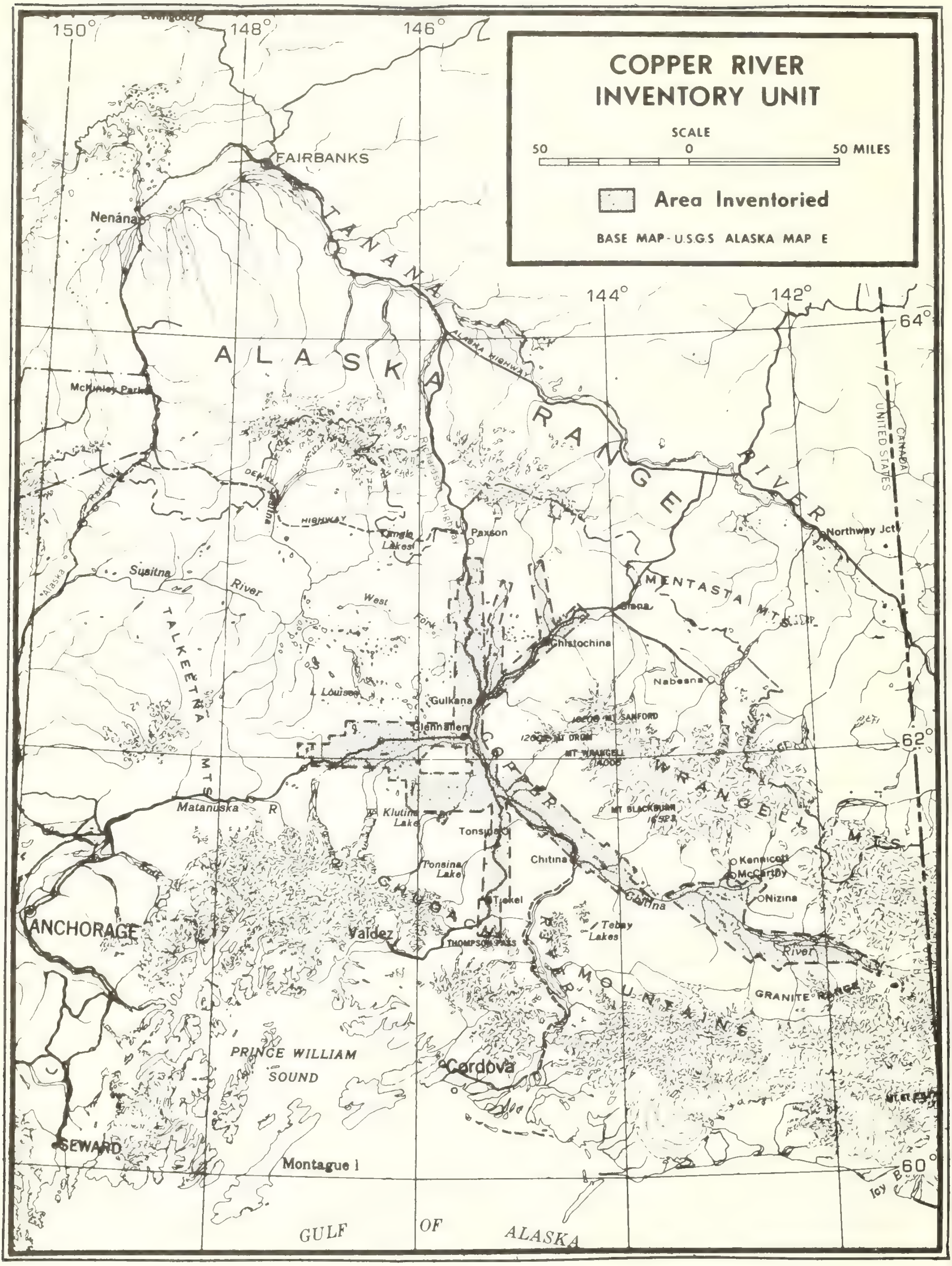


Figure 1.--Map of Copper River inventory unit.

elevation or higher and is dominated by the Wrangell Mountains immediately to the east (fig. 2), the Talkeetna and Chugach Mountains to the west and south, and the Alaska Range on the north. The valley, actually more of a plateau, is completely surrounded by these mountain ranges with all of the drainage flowing south to the Gulf of Alaska through a rock-walled gorge cut by the Copper River.

Access is good, with major highways north-south and east-west. Although the maximum allowable cut from all commercial forest lands is but 20 million board feet a year, road access to a deepwater port at Valdez could make some timber harvesting feasible (fig. 3). However, the greatest potential for this area seems to be in recreation, hunting, and esthetics, with logging activity likely to be only for local use.

Forest Description

At this northern latitude, 1,500 feet is commonly the elevational limit of commercial tree growth. Since this inventory unit is but 500 feet below that elevational limit, most stands are in the lower productivity classes. An indication of this is the high proportion of operable noncommercial stands which occupy a little over one-half as much area as do commercial stands. In other units inventoried, the operable noncommercial stands have occupied one-fourth or less as much area as did the commercial stands. Operable noncommercial stands are those carrying more than 800 cubic feet per acre but not growing at the Forest Survey minimum of 20 cubic feet per year. On air photos and on the ground, these marginal stands appear to have potential for harvest. In fact

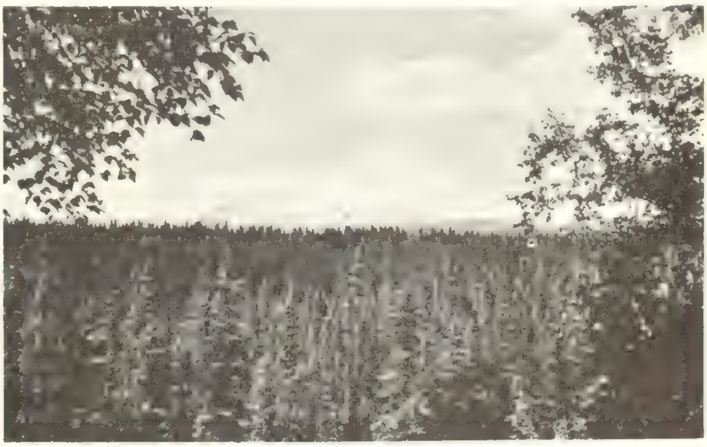


Figure 2.--Looking across an extensive stand of white spruce in the Copper River Valley toward Mount Drum (elevation 12,010 ft) of the Wrangell Mountains.

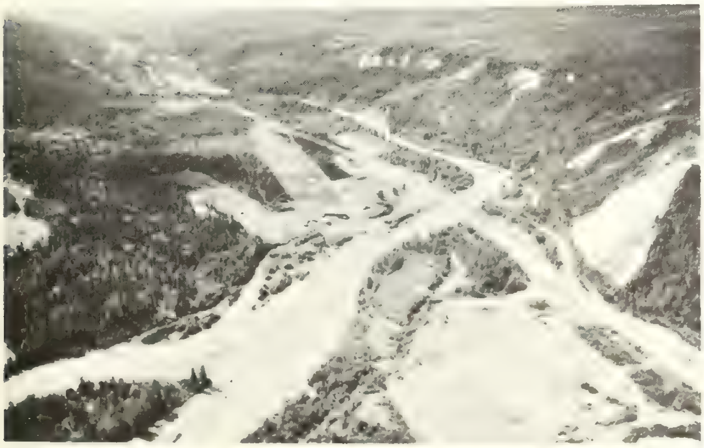


Figure 3.--Access to a deepwater port at Valdez is provided by this highway. The oil pipeline will almost parallel this road.

they appear commercial, but because of some restriction, such as poor soil, poor drainage, or high elevation, the site does not meet criteria for commercial classification.

The mountain ranges surrounding the Copper River Valley rise abruptly from the plateau confining most timber stands, including noncommercial, to a 5- to 25-mile-wide band along the larger rivers (fig. 4). The only exception is the Lake Louise area extending northwest to the Talkeetna Range and Alaska Range foothills. Within that area are many acres of the noncommercial, poorly drained, black spruce sites so typical of much of interior Alaska.

Both by area (76 percent) and volume (85 percent), white spruce type is predominant. Aspen is next, followed by cottonwood, with no birch type, although scatterings of birch are found mixed with other types. The best and highest volume stands are found along the Klutina River; other good stands are on river-bottom terraces and levees adjacent to the Copper and Chitina Rivers.

Forest Use

As illustrated in figure 5, the white spruce in this area is extremely limby and does not seem suited for sawn lumber except for local use. The generally low quality of the trees is shown in the volume distribution by log grades in table 23 where an unusually high proportion of volume is found in the local

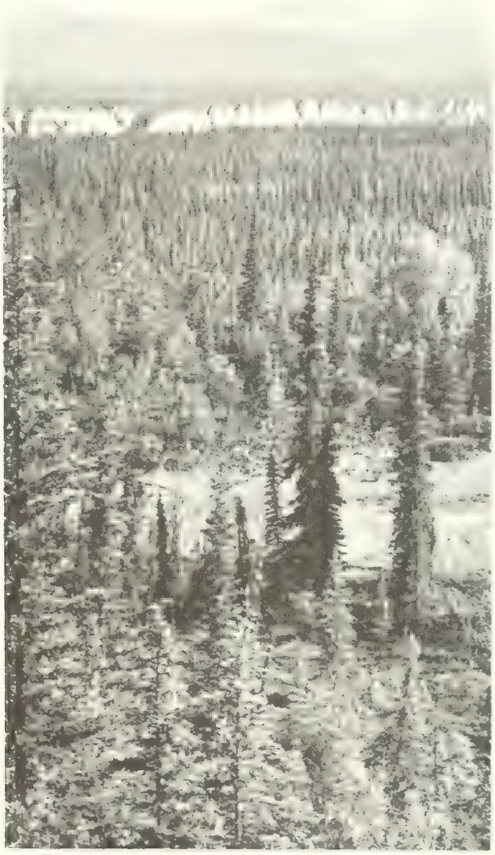


Figure 4.--As shown in this view and in figure 2, most forest stands are confined by the surrounding mountains to the valleys and lower foothills.

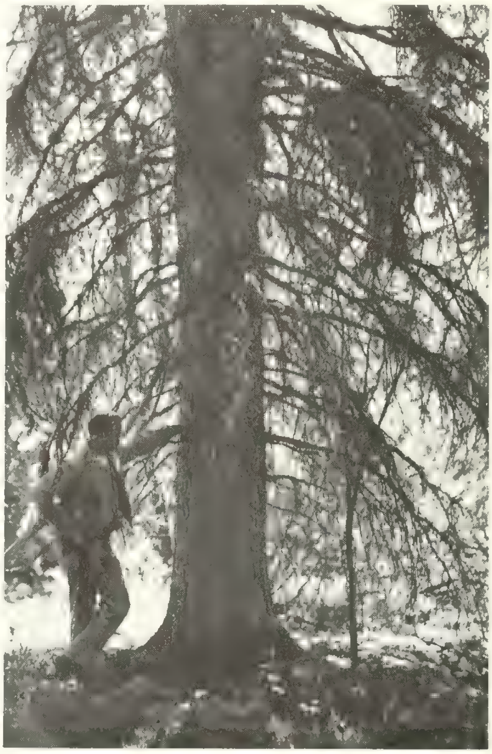


Figure 5.--As a result of the low stocking illustrated in the foreground of figure 4, most white spruce in the Copper River area exhibit excessive limbiness.

use (grade 4) category. The problem of extensive use for lumber is probably academic. The combination of low grade material and the expected fractionalized landownership pattern under the Alaska Native Claims Settlement Act make any large scale harvest operation difficult to arrange. The present pattern of local use for house logs and firewood is likely to continue.

The impact of the trans-Alaska pipeline on forest use is difficult to judge. White spruce would be adequate, limby or not, for cribbing and supports, but whether the diameters needed are adequately concentrated is difficult to say. More likely, pressure treated timber will be shipped in from the Pacific Northwest.

This state of noncompetitiveness may be an advantage. Anyone who has traveled this area in late spring and early summer must be impressed by the vivid green contrast the forests provide to the spectacular surrounding snow and ice-capped mountains. Continued local use may be the best use, with mining, recreation, hunting, and fishing providing a base for the local economy.

Defect

The age structure of the commercial forest stands in the area is heavily weighted to younger ages, a reflection of extensive fires in the past, with only about 20 percent of the area occupied by stands over 100 years old. This young age structure is reflected in the small amount of defect found. White spruce shows a 3.3-percent decrease from gross to net, with cottonwood at 4.6 percent, and no defect noted in aspen. A low 3-percent loss in spruce is not unexpected, but the small amount of defect estimated in hardwoods is surprising.

Regeneration

Regeneration does not seem to be a major problem in this area. Of a total commercial forest area of 287,800 acres, only 7,700 acres are classified nonstocked with 93,000 acres in the seedling-sapling category. Personal observations and the photographic evidence of figure 6 indicate no problems with regeneration in hardwoods; and although we observed areas of excellent white spruce reproduction, research findings indicate that good white spruce years are infrequent and that some regeneration problems might be expected (Zasada and Viereck 1970).

Table 5 lists 47,500 acres as poorly stocked. This may indicate a continuing problem of regeneration and would confirm research findings, since nearly all of the Copper River stands are in the white spruce type.

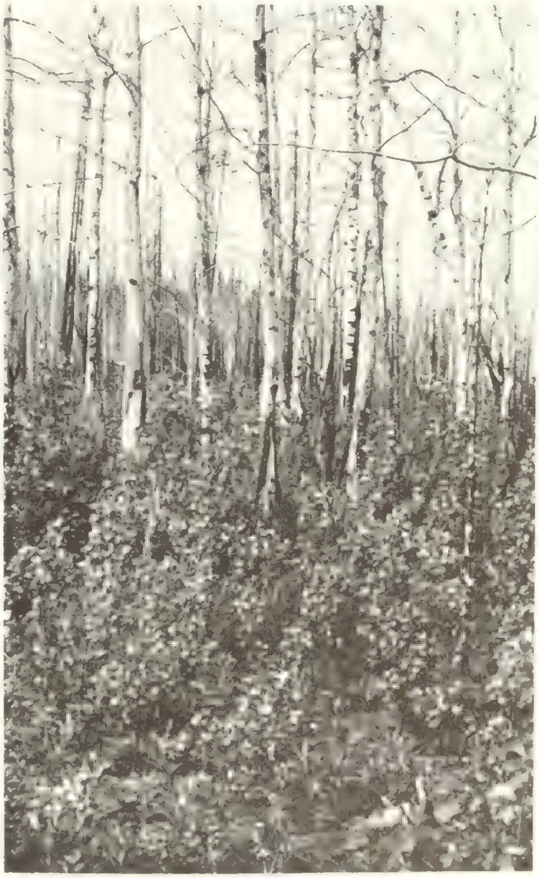


Figure 6.--This aspen stand was burned in 1957. Three years later, prolific reproduction is evident and is typical of much of the Copper River area and interior Alaska.

SURVEY METHODS

The estimates of area and timber volumes are based on a double sampling procedure (Bickford 1952). Enough 1-acre points to satisfy specific levels of statistical precision were uniformly distributed on aerial photographs. These points were classified on photographs by land type, forest type, and volume strata. A subsample was then drawn from all land types and reexamined on the photos. All subsample points originally classified as commercial forest land as well as any other subsample points questionably classified were visited on the ground.

For the Copper River inventory unit, we interpreted 7,201 photo points and reexamined 127 noncommercial and nonforest points. This reexamination was equivalent to a ground check and yielded 15 questionable points. These, with 151 commercial forest subsamples, totaled 166 locations actually checked on the ground. The ground plot was located at the exact point established on the photo. At each ground location, a 10-point cluster of plots was measured. A 40-factor basal-area gage was used to select sample trees at each point for detailed measurements of size and vigor. Through data processing procedures, the total sample and the individual tree volumes were expanded to obtain the various data needed or specified on area and volume. However, the tables herein depart from the standard Forest Survey tables in that we are adding a noncommercial forest category called "operable"--areas with more than 800 gross cubic feet per acre in poletimber and sawtimber trees. During the initial inventory of interior Alaska, we found that much noncommercial forest land had a relatively high per-acre volume. When more intensive inventories were begun in the mid-1960's, we and our cooperators agreed that some of this noncommercial strata had potential value as a commercial wood supply. By extrapolation from cutting minimums of 3 cords per acre used in the Lake States and Canada, we established 9 cords or 800 cubic feet per acre as a prudent level for Alaska. This threefold increase in the minimum economic operating level should compensate for the higher production and shipping costs in Alaska. The operable noncommercial areas presently have more than 800 gross cubic feet per acre in poletimber and sawtimber trees. The area and volume in this classification, although considered adequate for some cutting operations, should not be included in allowable cut computations. Future studies may show, through logging or other silvicultural practices, whether these marginal sites can be managed as commercial forest land. None of the reported areas and volumes (whether classed as commercial or other) should be used in any calculation of an allowable cut without consideration of possible management and land use alternatives.

SAMPLING ERROR

The reliability of the inventory is expressed in terms of relative sampling errors.

Area and volume	Design sampling error	Sampling error achieved	Sampling error of total area or volume reported
	- - - - - - - -	Percent	- - - -
Area:			
Commercial forest land, per million acres	3.0	6.0	12.0
Noncommercial forest land, per million acres	10.0	8.0	7.1
Volume:			
Commercial forest land, per billion cubic feet	6.0	6.0	11.0
Commercial forest land, growth per billion cubic feet	5.0	1.0	17.0

For the Copper River inventory unit, we report 303.8 million cubic feet of growing stock-volume ±11.0 percent. This means that unless a one in three chance has occurred, the true total cubic-foot volume is between 270.4 and 337.2 million cubic feet. We exceeded our design sampling error for area (3.0) and met the design error (6.0) for commercial forest land volume.

PRINCIPAL TREE SPECIES OF ALASKA[4]

Softwoods:	
Black spruce	*Picea mariana* (Mill.) B.S.P.
Tamarack	*Larix laricina* (Du Roi) K. Koch
White spruce	*Picea glauca* (Moench) Voss
Hardwoods:	
Balsam poplar	*Populus balsamifera* L.
Black cottonwood	*Populus trichocarpa* Torr. & Gray
Paper birch	*Betula papyrifera* Marsh.
Quaking aspen	*Populus tremuloides* Michx.

TERMINOLOGY

Allowable cut.--The volume of timber that could be cut on commercial forest land during a given period under specified management plans for sustained production such as those in effect on National Forests.

Area condition class.--Area condition class provides a general stratification of commercial forest land by management opportunity class as indicated by the stocking or area controlled by tree and cover class.

Area Condition Classification

Code	
10	Areas 100 percent or more stocked with desirable trees and not overstocked. Stands in this category generally do not require any treatment at present to maintain high level of growth.
20	Areas 100 percent or more stocked with desirable trees and overstocked. Stands in this category need a treatment such as thinning to produce maximum levels of growth of desirable trees.

---

[4] Scientific names are according to Little (1953).

30 Areas 60 to 100 percent stocked with desirable trees, and with less than 30 percent of the area controlled by acceptable growing-stock trees, cull trees, inhibiting vegetation, slash, or nonstockable conditions. Stands in this category generally have conditions favorable for natural improvement of stocking without special treatment.

40 Areas 60 to 100 percent stocked with desirable trees and with 30 percent or more of the area controlled by other trees (or overstocked areas) or conditions that ordinarily prevent occupancy by desirable trees. Stands in this category generally have little prospect for improvement in desirable tree stocking without special treatment such as thinning, cull tree removal, etc.

50 Areas less than 60 percent stocked with desirable trees but with 100-percent or more stocking with growing-stock trees. Stands in this category generally have little prospect for improved desirable tree stocking without special treatment. Stands almost to rotation age would usually not be treated.

60 Areas less than 60 percent stocked with desirable trees but with 60- to 100-percent stocking with growing-stock trees. Stands in this category generally have little prospect for improved desirable tree stocking without special treatment such as timber stand improvement or planting.

70 Areas less than 60 percent stocked with desirable trees and with less than 60-percent stocking with growing-stock trees. Stands in this category generally have little prospect for improved desirable tree or growing-stock stocking without treatment such as site preparation and regeneration, etc.

Commercial species.--Trees presently or prospectively suitable for industrial products.

Cull.--Portions of a tree unusable for industrial products because of rot, form, or other defect.

Cull trees.--Live trees of sawtimber or poletimber size unmerchantable for saw logs now or prospectively because of defect, rot, or species.

Rough trees: Live trees of 5.0-inch and larger d.b.h. that do not contain a saw log now or prospectively, primarily because of roughness, poor form, or because they are a noncommercial species.

Rotten trees: Live trees of 5.0-inch and larger d.b.h. that do not contain a saw log now or prospectively, primarily because of rot.

Forest land.--Land at least 16.7 percent stocked by forest trees of any size, or formerly having such tree cover, and not currently developed for nonforest use.

Commercial forest land: Forest land producing or capable of producing crops of industrial wood and not withdrawn from timber utilization. Areas qualifying as commercial forest land have the capability of producing in excess of 20 cubic feet per acre per year of industrial wood under management.

Noncommercial forest land: Unproductive forest land incapable of yielding crops of industrial wood because of adverse site conditions (producing less than 20 cubic feet per acre per year), and productive forest land withdrawn from commercial timber use through statute or administrative regulation.

Noncommercial operable--noncommercial forest land with a gross volume in excess of 800 cubic feet per acre.

Noncommercial inoperable--noncommercial forest land with a gross volume of less than 800 cubic feet per acre.

Forest types.--A classification of forest land based on the species forming a plurality of the live tree stocking.

Spruce: Forests in which a plurality of the stand is white spruce. Common associates include birch, aspen, and cottonwood.

Cottonwood: Forests in which a plurality of the stand is black cottonwood or balsam poplar or both. Common associates include white spruce and birch.

Aspen or birch: Forests in which a plurality of the stand is aspen or paper birch, or both. Common associates include black cottonwood and white spruce.

Growing-stock trees.--Sawtimber trees, poletimber trees, saplings, and seedlings; that is, all live trees except cull trees.

Desirable trees: Growing-stock trees with no serious defects in quality limiting present or prospective use, relatively high vigor, and no pathogens that could result in death or serious deterioration before rotation age. They include the type of trees forest managers aim to grow; that is, the trees left in silvicultural cutting or favored in cultural operations.

Acceptable trees: Trees meeting the specifications for growing stock but not qualifying as desirable.

Hardwoods.--Dicotyledonous trees, usually broad leaved and deciduous. Alaska hardwood species are paper birch, quaking aspen, black cottonwood and balsam poplar.

Inhibiting vegetation.--Cover sufficiently dense to prevent establishment of tree seedlings.

International 1/4-inch rule.--A rule used to determine the tree volume in board feet. (Bruce and Schumacher 1950).

Land area.--The area of dry land and land temporarily or partly covered by water such as marshes, swamps, and river flood plains (omitting tidal flats below mean high tide); streams, sloughs, estuaries, and canals less than 120 feet wide; and lakes, reservoirs, and ponds less than 1 acre in area.

Log grades.--A classification of logs based on external characteristics as indicators of quality or value.

Mean annual increment (MAI).--A measure of the volume of wood, in cubic feet, produced on 1 acre during 1 year. Forest Survey minimum standard for commercial forest land is the ability to produce 20 cubic feet per acre per year.

Mortality.--Number or sound-wood volume of live trees dying from natural causes during a 5-year period.

Net annual growth of growing stock.--The annual change in volume of sound wood in live sawtimber and poletimber trees.

Net annual growth of sawtimber.--The annual change in net board-foot volume of live sawtimber trees.

Net volume.--The gross volume of a tree less deductions for rot, sweep, or other defect affecting product use.

Growing-stock volume: The net volume of sound wood in the bole of growing stock, culls, and salvable dead trees 5.0 inches and larger in diameter at breast height, from stump to a minimum 4.0-inch top outside bark or to the point where the central stem breaks into limbs.

Noncommercial species.--Tree species of typically small size, poor form, or inferior quality which normally do not develop into trees suitable for industrial products.

Nonforest land.--Land that does not qualify as forest land. Includes land that has never supported forests and lands formerly forested where forest use is precluded by development for nonforest uses, such as crops, improved pasture, residential areas, and city parks. Also includes improved roads and certain areas of water classified by the Bureau of the Census as land. Unimproved roads, streams, canals, and nonforest strips in forest areas must be more than 120 feet wide, and clearings in forest areas must be more than 1 acre in size, to qualify as nonforest land.

Nonstockable land.--Areas of forest land not capable of supporting forest growth because of rock, water, etc.

Salvable dead trees.--Standing dead trees that are considered currently or potentially merchantable by regional standards. A poletimber tree must be more than one-half sound; a sawtimber tree more than one-third sound (board measure).

Saw log.--A log meeting minimum standards of diameter, length, and defect, including logs at least 8 feet long, sound and straight, and with a minimum diameter inside bark of 6 inches for softwoods (8 inches for hardwoods).

Saw log portion.--That part of the bole of sawtimber trees between the stump and the saw log top.

Saw log top.--The point on the bole of sawtimber trees above which a saw log cannot be produced. The minimum saw log top is 7.0-inch d.o.b. (diameter outside bark) for softwoods and 9.0-inch d.o.b. for hardwoods.

Site classes.--A classification of forest land by its capacity to grow crops of industrial wood.

Softwoods.--Coniferous trees, usually evergreen with needles or scalelike leaves.

Stocking.--The degree of occupancy of land by trees, measured by basal area or the number of trees in a stand by size or age and spacing, compared with the basal area or number of trees required to fully utilize the growth potential of the land; that is, the stocking standard.

Overstocked areas: Areas where growth of trees is significantly reduced by excessive numbers of trees.

Nonstocked areas: Commercial forest lands less than 16.7 percent stocked with growing-stock trees.

Stand-size classes.--A classification of forest land based on size of the growing stock present; that is, sawtimber, poletimber, or saplings and seedlings.

Sawtimber stands: Stands at least

16.7 percent stocked with growing-stock trees, with half or more of total stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

Poletimber stands: Stands at least 16.7 percent stocked with growing-stock trees of which half or more of this stocking is in poletimber and sawtimber trees, and with poletimber stocking exceeding that of sawtimber.

Sapling-seedling stands: Stands at least 16.7 percent stocked with growing-stock trees of which more than half of the stocking is saplings and seedlings.

Tree-size classes.--A classification based on the diameter of the tree at breast height (4-1/2 feet above the ground on the uphill side of the tree):

Sawtimber-size tree:
Softwood tree of 9.0-inch d.b.h. and larger.
Hardwood tree of 11.0-inch d.b.h. and larger.

Poletimber-size tree:
Softwood tree of 5.0- to 8.9-inch d.b.h.
Hardwood tree of 5.0- to 10.9-inch d.b.h.

Sapling-size tree: A tree of 1.0- to 4.9-inch d.b.h.
Seedling-size tree: A tree of less than 1.0-inch d.b.h.

Upper stem portion.--That part of the main stem or fork of sawtimber trees above the saw log top to a minimum top diameter of 4.0-inch outside bark or to the point where the main stem or fork breaks into limbs.

Water.--Bureau of the Census definition: Streams, sloughs, estuaries, and canals more than one-eighth of a statute mile in width; and lakes, reservoirs, and ponds more than 40 acres in area.

Forest Survey: The same as the Bureau of the Census definition, except minimum width of streams etc. is 120 feet and minimum size of lakes etc., is 1 acre.

TABLES

The statistical tables for the Copper River inventory unit have been prepared for the total unit and by three blocks--the Gulkana, Klutina, and Wrangell. The three blocks were management units established by the Bureau of Land Management before this inventory.

TABLE 1 --*Area by productivity and land class, Copper River inventory unit, Alaska, 1968*

Land class	Thousand acres
Forest land:	
Commercial	287.8
Noncommercial:	
Operable[1]	152.8
Inoperable[2]	1,191.3
Total	1,631.9
Nonforest land[3]	278.8
Total land	1,910.7
Census water	111.8
Total area	2,022.5

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

[2] Inoperable noncommercial forest land has a gross volume of less than 800 cubic feet per acre.

[3] Includes 44,800 acres of noncensus water. Noncensus water is defined as bodies of water 1 to 40 acres in size and watercourses 120 feet to 1/8 mile in width.

TABLE 2 --*Area of commercial and operable noncommercial forest land, by stand-size class, Copper River inventory unit, Alaska, 1968*

(Thousand acres)

Stand-size class	Forest land		
	Commercial	Operable noncommercial[1]	Total
Sawtimber stands	153.9	67.9	221.8
Poletimber stands	33.1	77.3	110.4
Seedling and sapling stands	93.1	7.6	100.7
Nonstocked areas	7.7	0	7.7
Total	287.8	152.8	440.6

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 3 --*Area of commercial and operable noncommercial forest land, by stand-volume class, Copper River inventory unit, Alaska, 1968*

(Thousand acres)

Stand volume (board feet per acre)[1]	Forest land		
	Commercial	Operable noncommercial[2]	Total
0 - 799	108.0	13.0	121.0
800 - 1,4999	6.9	24.0	30.9
1,500 - 2,999	36.1	34.3	70.4
3,000 - 4,999	44.3	74.3	118.6
5,000 - 6,999	27.6	7.2	34.8
More than 7,000	64.9	0	64.9
Total	287.8	152.8	440.6

[1] Net volume, International 1/4-inch rule.

[2] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 4--*Area of commercial and operable noncommercial*[1] *forest land, by stand-volume and stand-size classes, Copper River inventory unit, Alaska, 1968*

(Thousand acres)

Stand volume (net cubic feet per acre)	Stand-size class				
	Non-stocked	Seedling-sapling	Poletimber	Sawtimber	Total
0 - 299	7.7	66.7	2.1	0	76.5
300 - 799	0	28.3	22.1	40.3	90.7
800 - 1,499	0	5.7	61.2	110.5	177.4
1,500 - 2,199	0	0	21.4	40.7	62.1
More than 2,200	0	0	3.6	30.3	33.9
Total	7.7	100.7	110.4	221.8	440.6

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 5--*Area of commercial forest land by area condition class, Copper River inventory unit, Alaska, 1968*

Code	Area condition class	Thousand acres
10	Areas 100 percent or more stocked with desirable trees and not overstocked	11.4
20	Areas 100 percent or more stocked with desirable trees and overstocked	1.2
30	Areas 60 to 100 percent stocked with desirable trees, and with less than 30 percent of the area controlled by acceptable growing-stock trees, cull trees, inhibiting vegetation, slash, or nonstockable conditions	34.2
40	Areas 60 to 100 percent stocked with desirable trees and with 30 percent or more of the area controlled by other trees (or overstocked areas) or conditions that ordinarily prevent occupancy by desirable trees	26.0
50	Areas less than 60 percent stocked with desirable trees, but with 100-percent or more stocking with growing-stock trees	42.7
60	Areas less than 60 percent stocked with desirable trees, but with 60- to 100-percent stocking with growing-stock trees	124.8
70	Areas less than 60 percent stocked with desirable trees, and with less than 60-percent stocking with growing-stock trees	47.5
All classes		287.8

TABLE 6--*Area of commercial forest land, by site class, Copper River inventory unit, Alaska, 1968*

Site class[1] (cubic feet)	Thousand acres
165 or more[2]	0
120 - 164	0
85 - 119	0
50 - 84	0
Less than 50	287.8
Total	287.8

[1] Site class is a classification of forest land by its capability to grow crops of industrial wood based on fully stocked natural stands.

[2] Potential yield, mean annual increment.

TABLE 7--*Area of commercial and noncommercial forest land, by forest type, Copper River inventory unit, Alaska, 1968*

(Thousand acres)

Forest type	Commercial forest land	Noncommercial forest land		
		Operable[1]	Inoperable[2]	Total
Balsam poplar	22.5	0	0	0
Black spruce	--	7.9	1,166.0	1,173.9
Paper birch	0	0	0	0
Quaking aspen	38.5	5.4	0	5.4
White spruce	219.1	139.5	25.3	164.8
Nonstocked	7.7	0	0	0
Total	287.8	152.8	1,191.3	1,344.1

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

[2] Inoperable noncommercial forest land has a gross volume of less than 800 cubic feet per acre. Most of the inoperable noncommercial forest land is assumed to be black spruce, although other types, in addition to the 25,300 acres of white spruce, may be represented.

TABLE 8--*Area of commercial forest land, by stand age and stand-size class, Copper River inventory unit, Alaska, 1968*

(Thousand acres)

Stand age (years)	Stand-size class				
	Nonstocked	Sapling-seedling	Poletimber	Sawtimber	Total
Nonstocked	--	--	--	--	--
1 - 9	2.4	2.4	0	0	4.8
10 - 19	2.8	11.5	0	0	14.3
20 - 29	0	15.9	0	0	15.9
30 - 39	0	23.8	2.4	0	26.2
40 - 49	0	5.8	2.2	0	8.0
50 - 59	0	2.9	10.3	2.9	16.1
60 - 69	0	1.2	2.3	16.4	19.9
70 - 79	0	0	4.7	18.0	22.7
80 - 89	0	10.9	7.6	12.1	30.6
90 - 99	0	0	0	19.2	19.2
100-119	0	0	0	13.5	13.5
120-139	0	2.8	2.4	14.6	19.8
140-159	0	0	0	14.4	14.4
160-179	0	0	0	15.6	15.6
180-199	0	0	0	0	0
200-299	0	0	0	0	0
300 and over	0	0	0	0	0
Mixed ages	2.5	15.9	1.2	27.2	46.8
Total	7.7	93.1	33.1	153.9	287.8

TABLE 9--*Area of operable noncommercial*[1] *forest land, by stand age and stand-size class, Copper River inventory unit, Alaska, 1968*

(Thousand acres)

Stand age (years)	Stand-size class				
	Nonstocked	Sapling-seedling	Poletimber	Sawtimber	Total
1 - 9	0	0	0	0	0
10 - 19	0	0	0	0	0
20 - 29	0	0	0	0	0
30 - 39	0	0	0	0	0
40 - 49	0	0	0	0	0
50 - 59	0	0	0	0	0
60 - 69	0	0	2.9	10.5	13.4
70 - 79	0	0	2.8	0	2.8
80 - 89	0	4.7	0	0	4.7
90 - 99	0	0	11.6	5.4	17.0
100-119	0	0	16.0	3.7	19.7
120-139	0	0	11.2	21.8	33.0
140-159	0	2.9	8.2	2.5	13.6
160-179	0	0	2.4	2.5	4.9
180-199	0	0	0	10.9	10.9
200-299	0	0	4.7	4.8	9.5
300 and over	0	0	0	0	0
Mixed ages	0	0	17.5	5.8	23.3
Total	0	7.6	77.3	67.9	152.8

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 10--*Number of growing-stock trees on commercial forest land, by diameter class and species, Copper River inventory unit, Alaska, 1968*

(Thousand trees)

Diameter class (inches d.b.h.)	Balsam poplar	Paper birch	Quaking aspen	White spruce	Total
1.0-2.9	5,071.2	138.8	7,316.9	54,408.0	66,934.9
3.0-4.9	3,339.0	0	8,583.4	21,487.6	33,410.0
5.0-6.9	1,646.2	0	2,027.1	10,540.6	14,213.9
7.0-8.9	1,026.4	18.5	1,495.6	8,384.1	10,924.6
9.0-10.9	319.7	19.6	440.9	5,039.8	5,820.0
11.0-12.9	308.3	0	127.4	2,561.5	2,997.2
13.0-14.9	221.6	0	21.9	1,770.1	2,013.6
15.0-16.9	42.0	0	15.0	470.3	527.3
17.0-18.9	46.6	0	0	261.2	307.8
19.0-20.9	23.2	0	0	87.1	110.3
21.0-28.9	53.7	0	0	32.1	85.8
29.0+	3.4	0	0	0	3.4
Total	12,101.3	176.9	20,028.2	105,042.4	137,348.8

TABLE 11--*Number of growing-stock trees 5.0-inch d.b.h. and larger on commercial and operable noncommercial*[1] *forest land, by height class and species, Copper River inventory unit, Alaska, 1968*

(Thousand trees)

5-foot height classes	Balsam poplar	Paper birch	Quaking aspen	White spruce	Total
0 - 30	697.7	116.2	800.9	8,819.1	10,433.9
31 - 35	628.1	199.4	558.2	8,758.7	10,144.4
36 - 40	1,068.8	86.1	1,114.0	8,081.0	10,349.9
41 - 45	1,147.1	80.4	1,341.8	7,797.0	10,366.3
46 - 50	200.2	21.9	1,100.2	7,433.1	8,755.4
51 - 55	168.6	37.1	642.2	5,265.7	6,113.6
56 - 60	282.3	0	312.3	4,599.3	5,193.9
61 - 65	200.5	0	42.5	2,732.2	2,975.2
66 - 70	125.0	0	34.8	1,276.1	1,435.9
71 - 75	1.8	0	0	904.8	906.6
76 - 80	38.8	0	7.9	459.8	506.5
81 - 85	25.6	0	7.0	188.6	221.2
86 - 90	0	0	0	94.9	94.9
91 - 95	0	0	0	28.6	28.6
96 - 100	0	0	0	15.1	15.1
101+	0	0	0	6.5	6.5
Total	4,584.5	541.1	5,961.8	56,460.5	67,547.9

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 12--*Net volume of timber on commercial and operable noncommercial forest land, by class of timber and softwoods and hardwoods, Copper River inventory unit, Alaska, 1968*

(Million cubic feet)

Class of timber	Commercial forest land			Operable noncommercial forest land[1/]		
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total
Sawtimber trees:						
Saw-log portion	141.7	16.9	158.6	55.2	2.3	57.5
Upper-stem portion	42.3	1.7	44.0	16.5	.3	16.8
Total	184.0	18.6	202.6	71.7	2.6	74.3
Poletimber trees	75.7	25.5	101.2	74.9	8.7	83.6
All growing-stock trees	259.7	44.1	303.8	146.6	11.3	157.9
Rough trees	2.0	.4	2.4	7.2	0	7.2
Rotten trees	3.1	.7	3.8	1.7	.4	2.1
Salvable dead trees	2.7	0	2.7	1.0	0	1.0
Total	267.5	45.2	312.7	156.5	11.7	168.2

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet pe acre.

TABLE 13--*Net volume of growing stock on commercial forest land, by species and diameter class, Copper River inventory unit, Alaska, 1968*

(Million cubic feet)

Species	Diameter class (inches at breast height)										
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+	Total
Softwoods:											
White spruce	25.2	50.5	57.4	45.6	44.4	16.8	12.5	5.3	2.0	0	259.7
Total	25.2	50.5	57.4	45.6	44.4	16.8	12.5	5.3	2.0	0	259.7
Hardwoods:											
Balsam poplar	2.5	3.7	2.5	3.7	4.1	1.2	1.5	1.0	3.8	.4	24.4
Paper birch	0	.1	.1	0	0	0	0	0	0	0	.2
Quaking aspen	5.3	8.1	3.2	1.7	.5	.7	0	0	0	0	19.5
Total	7.8	11.9	5.8	5.4	4.6	1.9	1.5	1.0	3.8	.4	44.1
All species	33.0	62.4	63.2	51.0	49.0	18.7	14.0	6.3	5.8	.4	303.8

TABLE 14--*Net volume of growing stock on commercial and operable noncommercial*[1] *forest land, by species and diameter class, Copper River inventory unit, Alaska, 1968*

(Million cubic feet)

Species	Diameter class (inches at breast height)										
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+	Total
Softwoods:											
White spruce	56.0	94.6	87.4	68.2	59.2	20.2	13.1	5.6	2.0	0	406.3
Total	56.0	94.6	87.4	68.2	59.2	20.2	13.1	5.6	2.0	0	406.3
Hardwoods:											
Balsam poplar	3.1	4.4	3.3	3.8	4.1	1.3	1.5	1.1	3.8	.4	26.8
Paper birch	.3	.6	.8	.4	0	0	0	0	0	0	2.1
Quaking aspen	7.4	9.6	4.7	2.3	1.5	.8	.3	0	0	0	26.6
Total	10.8	14.6	8.8	6.5	5.6	2.1	1.8	1.1	3.8	.4	55.5
All species	66.8	109.2	96.2	74.7	64.8	22.3	14.9	6.7	5.8	.4	461.8

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 15--*Net volume of sawtimber on commercial forest land, by species and diameter class, Copper River inventory unit, Alaska, 1968*

(Million board feet, International 1/4-inch rule)

Species	Diameter class (inches at breast height)								
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+	Total
Softwoods:									
White spruce	343.2	265.4	260.1	97.7	72.2	30.8	11.3	0	1,080.7
Total	343.2	265.4	260.1	97.7	72.2	30.8	11.3	0	1,080.7
Hardwoods:									
Balsam poplar	0	9.4	16.3	5.6	7.5	5.3	20.7	2.4	67.2
Paper birch	0	0	0	0	0	0	0	0	0
Quaking aspen	0	6.5	2.0	3.2	0	0	0	0	11.7
Total	0	15.9	18.3	8.8	7.5	5.3	20.7	2.4	78.9
All species	343.2	281.3	278.4	106.5	79.7	36.1	32.0	2.4	1,159.6

TABLE 16--*Net volume of sawtimber on commercial and operable noncommercial*[1/] *forest land, by species and diameter class, Copper River inventory unit, Alaska, 1968*

(Million board feet, International 1/4-inch rule)

Species	Diameter class (inches at breast height)								
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+	Total
Softwoods:									
White spruce	523.6	397.8	347.1	116.8	75.5	32.6	11.3	0	1,504.7
Total	523.6	397.8	347.1	116.8	75.5	32.6	11.3	0	1,504.7
Hardwoods:									
Balsam poplar	0	9.6	16.3	5.6	7.5	5.3	20.7	2.4	67.4
Paper birch	0	.9	0	0	0	0	0	0	.9
Quaking aspen	0	8.6	6.2	4.0	1.3	0	0	0	20.1
Total	0	19.1	22.5	9.6	8.8	5.3	20.7	2.4	88.4
All classes	523.6	416.9	369.6	126.4	84.3	37.9	32.0	2.4	1,593.1

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 17--*Gross volume of sawtimber on commercial forest land, by species and diameter class, Copper River inventory unit, Alaska, 1968*

(Million board feet, International 1/4-inch rule)

Species	Diameter class (inches at breast height)								
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+	Total
Softwoods:									
White spruce	347.9	274.3	270.9	103.0	76.0	31.9	13.4	0	1,117.4
Total	347.9	274.3	270.9	103.0	76.0	31.9	13.4	0	1,117.4
Hardwoods:									
Balsam poplar	0	10.2	17.7	5.6	8.3	5.4	20.8	2.4	70.4
Paper birch	0	0	0	0	0	0	0	0	0
Quaking aspen	0	6.5	2.0	3.2	0	0	0	0	11.7
Total	0	16.7	19.7	8.8	8.3	5.4	20.8	2.4	82.1
All species	347.9	291.0	290.6	111.8	84.3	37.3	34.2	2.4	1,199.5

TABLE 18--*Gross volume of sawtimber on commercial and operable noncommercial*[1/] *forest land, by species and diameter class, Copper River inventory unit, Alaska, 1968*

(Million board feet, International 1/4-inch rule)

Species	Diameter class (inches at breast height)								
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+	Total
Softwoods:									
White spruce	531.5	411.4	366.7	125.6	80.5	33.6	13.4	0	1,562.7
Total	531.5	411.4	366.7	125.6	80.5	33.6	13.4	0	1,562.7
Hardwoods:									
Balsam poplar	0	10.6	17.7	5.6	8.3	5.4	20.8	2.4	70.8
Paper birch	0	1.2	0	0	0	0	0	0	1.2
Quaking aspen	0	9.0	6.7	4.0	1.6	0	0	0	21.3
Total	0	20.8	24.4	9.6	9.9	5.4	20.8	2.4	93.3
All species	531.5	432.2	391.1	135.2	90.4	39.0	34.2	2.4	1,656.0

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 19--*Net volume of growing stock on commercial forest land by forest type and softwoods and hardwoods, Copper River inventory unit, Alaska, 1968*

(Thousand cubic feet)

Forest type	Softwoods	Hardwoods	Total
Balsam poplar	9,485.1	18,938.9	28,424.0
Quaking aspen	2,956.8	14,582.2	17,539.0
White spruce	247,290.0	10,592.5	257,882.5
Total	259,731.9	44,113.6	303,845.5

TABLE 20--*Net volume of growing stock on operable noncommercial*[1] *forest land by forest type and softwoods and hardwoods, Copper River inventory unit, Alaska, 1968*

(Thousand cubic feet)

Forest type	Softwoods	Hardwoods	Total
Black spruce	1,607.6	1,051.5	2,659.1
Quaking aspen	911.7	4,131.7	5,043.4
White spruce	144,090.8	6,117.0	150,207.8
Total	146,610.1	11,300.2	157,910.3

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 21--*Net volume of sawtimber on commercial forest land by forest type and softwoods and hardwoods, Copper River inventory unit, Alaska, 1968*

(Thousand board feet)

Forest type	Softwood	Hardwood	Total
Balsam poplar	53,462.4	58,164.6	111,627.0
Quaking aspen	12,645.9	7,255.1	19,901.0
White spruce	1,014,598.9	13,460.2	1,028,059.1
Total	1,080,707.2	78,879.9	1,159,587.1

TABLE 22--*Net volume of sawtimber on operable noncommercial*[1/] *forest land by forest type and softwoods and hardwoods, Copper River inventory unit, Alaska, 1968*

(Thousand board feet)

Forest type	Softwood	Hardwood	Total
Black spruce	8,366.6	2,350.8	10,717.4
Quaking aspen	4,567.8	6,085.5	10,653.3
White spruce	411,092.8	1,063.4	412,156.2
Total	424,027.2	9,499.7	433,526.9

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 23--*Net volume of sawtimber on commercial forest land, by species and log grade, Copper River inventory unit, Alaska, 1968*

(Million board feet, International 1/4-inch rule)

Species	Log grade[1/]				
	1	2	3	4[2/]	Total
Softwoods:					
White spruce	0.3	73.6	783.1	223.7	1,080.7
Total	.3	73.6	783.1	223.7	1,080.7
Hardwoods:					
Balsam poplar	12.0	18.2	31.2	5.8	67.2
Paper birch	0	0	0	0	0
Quaking aspen	.6	1.5	5.5	4.1	11.7
Total	12.6	19.7	36.7	9.9	78.9
All species	12.9	93.3	819.8	233.6	1,159.6

[1/] Forest Products Laboratory. Hardwood log grades for standard lumber. USDA Forest Products Laboratory Report R1737, 61 p., 1959.

Northern Hemlock and Hardwood Manufacturers Association. Official grading rules for northern hardwood and softwood logs and tie cuts. Green Bay, Wisconsin, 12 p., 1959.

[2/] Logs used locally.

TABLE 24--*Net volume of sawtimber on operable noncommercial*[1] *forest land, by species and log grade, Copper River inventory unit, Alaska, 1968*

(Million board feet, International 1/4-inch rule)

Species	Log grade[2]				
	1	2	3	4[3]	Total
Softwoods:					
White spruce	0	2.4	326.6	95.0	424.0
Total	0	2.4	326.6	95.0	424.0
Hardwoods:					
Balsam poplar	0	0	.3	0	.3
Paper birch	0	0	.8	0	.8
Quaking aspen	0	5.0	3.1	.3	8.4
Total	0	5.0	4.2	.3	9.5
All species	0	7.4	330.8	95.3	433.5

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

[2] Forest Products Laboratory. Hardwood log grades for standard lumber. USDA Forest Products Laboratory Report R1737, 61 p., 1959.

Northern Hemlock and Hardwood Manufacturers Association. Official grading rules for northern hardwood and softwood logs and tie cuts. Green Bay, Wisconsin, 12 p., 1959.

[3] Logs used locally.

TABLE 25--*Net annual growth of growing stock, by species and forest-land class, Copper River inventory unit, Alaska, 1968*

(Thousand cubic feet)

Species	Commercial forest land	Operable noncommercial forest land[1]	Total
Softwoods:			
White spruce	3,174.2	1,677.2	4,851.4
Total	3,174.2	1,677.2	4,851.4
Hardwoods:			
Balsam poplar	458.4	25.9	484.3
Paper birch	3.1	27.6	30.7
Quaking aspen	614.9	142.9	757.8
Total	1,076.4	196.4	1,272.8
All species	4,250.6	1,873.6	6,124.2

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 26--*Net annual growth of sawtimber, by species and forest-land class, Copper River inventory unit, Alaska, 1968*

(Thousand board feet, International 1/4-inch rule)

Species	Commercial forest land	Operable noncommercial forest land[1]	Total
Softwoods:			
White spruce	19,537.8	17,354.2	36,892.0
Total	19,537.8	17,354.2	36,892.0
Hardwoods:			
Balsam poplar	2,418.2	8.2	2,426.4
Paper birch	0	859.9	859.9
Quaking aspen	1,185.3	192.7	1,378.0
Total	3,603.5	1,060.8	4,664.3
All species	23,141.3	18,415.0	41,556.3

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 27--*Annual mortality of growing stock, by species and forest-land class, Copper River inventory unit, Alaska, 1968*

(Thousand cubic feet)

Species	Commercial forest land	Operable noncommercial forest land[1]	Total
Softwoods:			
White spruce	314.3	190.6	504.9
Total	314.3	190.6	504.9
Hardwoods:			
Balsam poplar	0	0	0
Paper birch	0	0	0
Quaking aspen	0	0	0
Total	0	0	0
All species	314.3	190.6	504.9

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 28--*Annual mortality of sawtimber, by species and forest-land class, Copper River inventory unit, Alaska, 1968*

(Thousand board feet, International 1/4-inch rule)

Species	Commercial forest land	Operable noncommercial forest land[1]	Total
Softwoods:			
White spruce	1,610.4	225.7	1,836.1
Total	1,610.4	225.7	1,836.1
Hardwoods:			
Balsam poplar	0	0	0
Paper birch	0	0	0
Quaking aspen	0	0	0
Total	0	0	0
All species	1,610.4	225.7	1,836.1

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 29--*Annual mortality of growing stock on commercial and noncommercial forest land, by cause and by softwoods and hardwoods, Copper River inventory unit, Alaska, 1968*

(Thousand cubic feet)

Cause	Commercial forest land			Operable noncommercial forest land[1]		
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total
Fire	0	0	0	0	0	0
Insects	37.6	0	37.6	0	0	0
Disease	0	0	0	0	0	0
Windthrow	23.9	0	23.9	0	0	0
Other	17.0	0	17.0	137.6	0	137.6
Unknown	235.8	0	235.8	53.0	0	53.0
Total	314.3	0	314.3	190.6	0	190.6

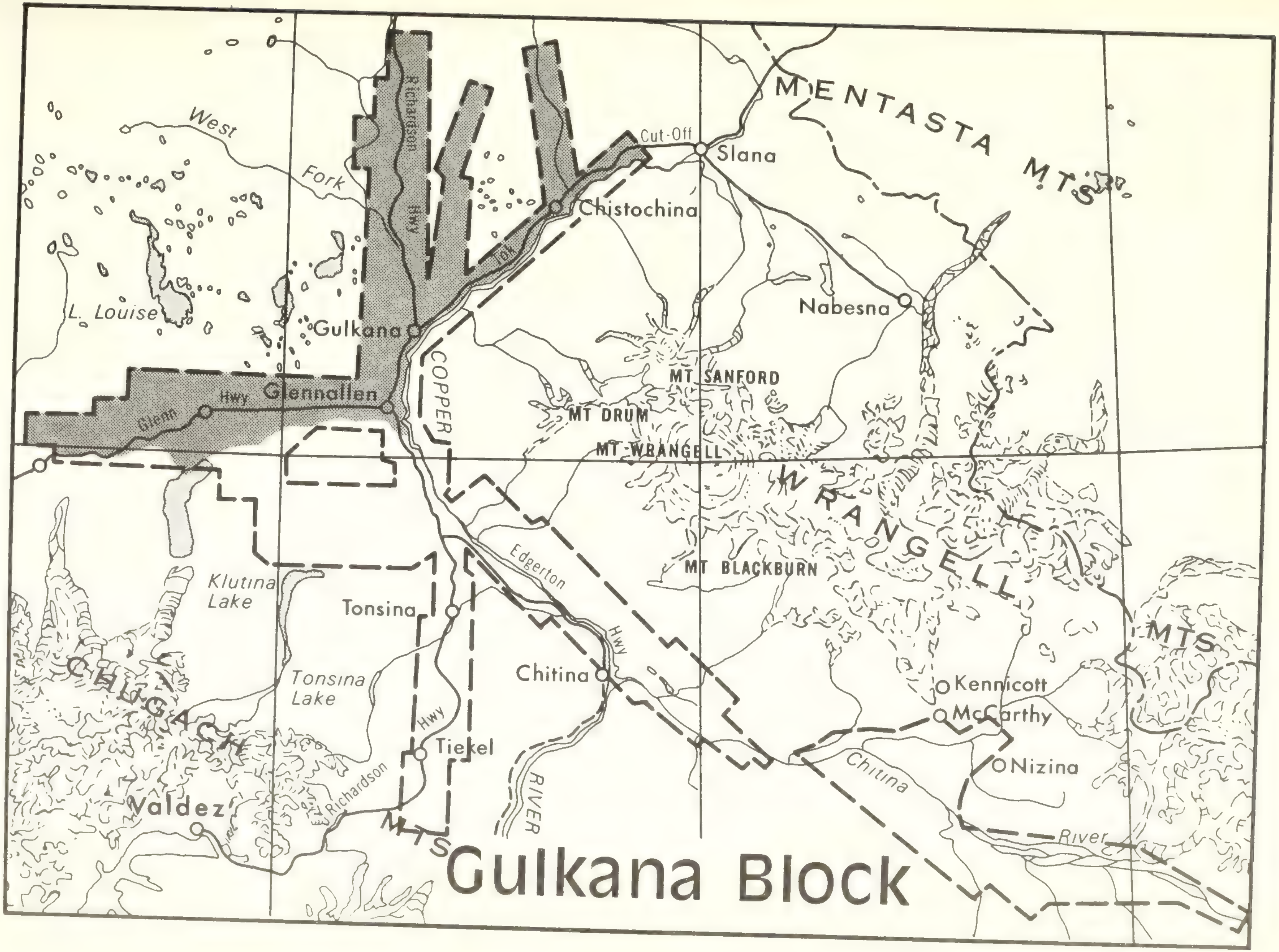
[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 30--*Annual mortality of sawtimber on commercial and noncommercial forest land, by cause and by softwoods and hardwoods, Copper River inventory unit, Alaska, 1968*

(Thousand board feet, International 1/4-inch rule)

Cause	Commercial forest land			Operable noncommercial forest land[1]		
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total
Fire	0	0	0	0	0	0
Insects	238.4	0	238.4	0	0	0
Disease	0	0	0	0	0	0
Windthrow	0	0	0	0	0	0
Other	42.9	0	42.9	225.7	0	225.7
Unknown	1,329.1	0	1,329.1	0	0	0
Total	1,610.4	0	1,610.4	225.7	0	225.7

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.



Gulkana Block

TABLE 31--*Area by productivity and land class, Gulkana block, Copper River inventory unit, Alaska, 1968*

Land class	Thousand acres
Forest land:	
Commercial	39.1
Noncommercial:	
Operable[1]	26.7
Inoperable[2]	571.8
Total	637.6
Nonforest land[3]	130.1
Total land	767.7
Census water	21.9
Total area	789.6

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

[2] Inoperable noncommercial forest land has a gross volume of less than 800 cubic feet per acre.

[3] Includes 28,100 acres of noncensus water. Noncensus water is defined as bodies of water 1 to 40 acres in size and watercourses 120 feet to 1/8 mile in width.

TABLE 32--*Area of commercial and operable noncommercial forest land, by stand-size class, Gulkana block, Copper River inventory unit, Alaska, 1968*

(Thousand acres)

Stand-size class	Forest land		
	Commercial	Operable noncommercial[1]	Total
Sawtimber stands	12.3	10.6	22.9
Poletimber stands	12.7	11.4	24.1
Seedling and sapling stands	14.1	4.7	18.8
Nonstocked areas	0	0	0
Total	39.1	26.7	65.8

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 33--*Area of commercial forest land by area condition class, Gulkana block, Copper River inventory unit, Alaska, 1968*

Code	Area condition class	Thousand acres
10	Areas 100 percent or more stocked with desirable trees and not overstocked	2.3
20	Areas 100 percent or more stocked with desirable trees and overstocked	1.2
30	Areas 60 to 100 percent stocked with desirable trees, and with less than 30 percent of the area controlled by acceptable growing-stock trees, cull trees, inhibiting vegetation, slash, or nonstockable conditions	13.9
40	Areas 60 to 100 percent stocked with desirable trees and with 30 percent or more of the area controlled by other trees (or overstocked areas) or conditions that ordinarily prevent occupancy by desirable trees	5.5
50	Areas less than 60 percent stocked with desirable trees, but with 100-percent or more stocking with growing-stock trees	2.3
60	Areas less than 60 percent stocked with desirable trees, but with 60- to 100-percent stocking with growing-stock trees	11.5
70	Areas less than 60 percent stocked with desirable trees, and with less than 60-percent stocking with growing-stock trees	2.4
All classes		39.1

TABLE 34--*Area of commercial and noncommercial forest land, by forest type, Gulkana block, Copper River inventory unit, Alaska, 1968*

(Thousand acres)

Forest type	Commercial forest land	Noncommercial forest land		
		Operable[1]	Inoperable[2]	Total
Balsam poplar	12.7	0	0	0
Black spruce	--	2.2	571.8	574.0
Paper birch	0	0	0	0
Quaking aspen	1.2	0	0	0
White spruce	25.2	24.5	0	24.5
Nonstocked	0	0	0	0
Total	39.1	26.7	571.8	598.5

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

[2] Inoperable noncommercial forest land has a gross volume of less than 800 cubic feet per acre. All inoperable noncommercial forest land is assumed to be black spruce although other forest types may be represented.

TABLE 35--*Net volume of timber on commercial and operable noncommercial forest land, by class of timber and softwoods and hardwoods, Gulkana block, Copper River inventory unit, Alaska, 1968*

(Million cubic feet)

Class of timber	Commercial forest land			Operable noncommercial forest land[1]		
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total
Sawtimber trees:						
Saw-log portion	12.1	3.6	15.7	8.6	0	8.6
Upper-stem portion	3.6	.4	4.0	2.5	0	2.5
Total	15.7	4.0	19.7	11.1	0	11.1
Poletimber trees	11.2	4.8	16.0	10.7	.8	11.5
All growing-stock trees	26.9	8.8	35.7	21.8	.8	22.6
Rough trees	.1	0	.1	2.0	0	2.0
Rotten trees	0	.3	.3	.8	.3	1.1
Salvable dead trees	0	0	0	0	0	0
Total	27.0	9.1	36.1	24.6	1.1	25.7

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 36--*Net volume of growing stock on commercial forest land by forest type and softwoods and hardwoods, Gulkana block, Copper River inventory unit, Alaska, 1968*

(Thousand cubic feet)

Forest type	Softwoods	Hardwoods	Total
Balsam poplar	820.6	5,698.8	6,519.4
Quaking aspen	0	624.3	624.3
White spruce	26,064.4	2,508.5	28,572.9
Total	26,885.0	8,831.6	35,716.6

TABLE 37--*Net volume of growing stock on operable noncommercial*[1] *forest land by forest type and softwoods and hardwoods, Gulkana block, Copper River inventory unit, Alaska, 1968*

(Thousand cubic feet)

Forest type	Softwoods	Hardwoods	Total
Black spruce	0	0	0
Quaking aspen	0	0	0
White spruce	21,815.3	832.9	22,648.2
Total	21,815.3	832.9	22,648.2

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 38--*Net volume of sawtimber on commercial forest land by forest type and softwoods and hardwoods, Gulkana block, Copper River inventory unit, Alaska, 1968*

(Thousand board feet, International 1/4-inch rule)

Forest type	Softwoods	Hardwoods	Total
Balsam poplar	3,417.1	7,623.1	11,040.2
Quaking aspen	0	0	0
White spruce	88,621.9	5,199.4	93.821.3
Total	92,039.0	12,822.5	104,861.5

TABLE 39--*Net volume of sawtimber on operable noncommercial*[1/] *forest land by forest type and softwoods and hardwoods, Gulkana block, Copper River inventory unit, Alaska, 1968*

(Thousand board feet, International 1/4-inch rule)

Forest type	Softwoods	Hardwoods	Total
Black spruce	0	0	0
Quaking aspen	0	0	0
White spruce	65,521.1	0	65,521.1
Total	65,521.1	0	65,521.1

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 40--*Net volume of sawtimber on commercial forest land, by species and log grade, Gulkana block, Copper River inventory unit, Alaska, 1968*

(Million board feet, International 1/4-inch rule)

Species	Log grade[1/]				
	1	2	3	4[2/]	Total
Softwoods:					
White spruce	0.3	6.3	58.2	27.2	92.0
Total	.3	6.3	58.2	27.2	92.0
Hardwoods:					
Balsam poplar	0	1.2	8.8	1.6	11.6
Paper birch	0	0	0	0	0
Quaking aspen	0	.2	.7	.4	1.3
Total	0	1.4	9.5	2.0	12.9
All species	.3	7.7	67.7	29.2	104.9

[1/] Forest Products Laboratory. Hardwood log grades for standard lumber. USDA Forest Products Laboratory Report R1737, 61 p., 1959.

Northern Hemlock and Hardwood Manufacturers Association. Official grading rules for northern hardwood and softwood logs and tie cuts. Green Bay, Wisconsin, 12 p., 1959.

[2/] Logs used locally.

TABLE 41--*Net volume of sawtimber on operable noncommercial*[1] *forest land, by species and log grade, Gulkana block, Copper River inventory unit, Alaska, 1968*

(Million board feet, International 1/4-inch rule)

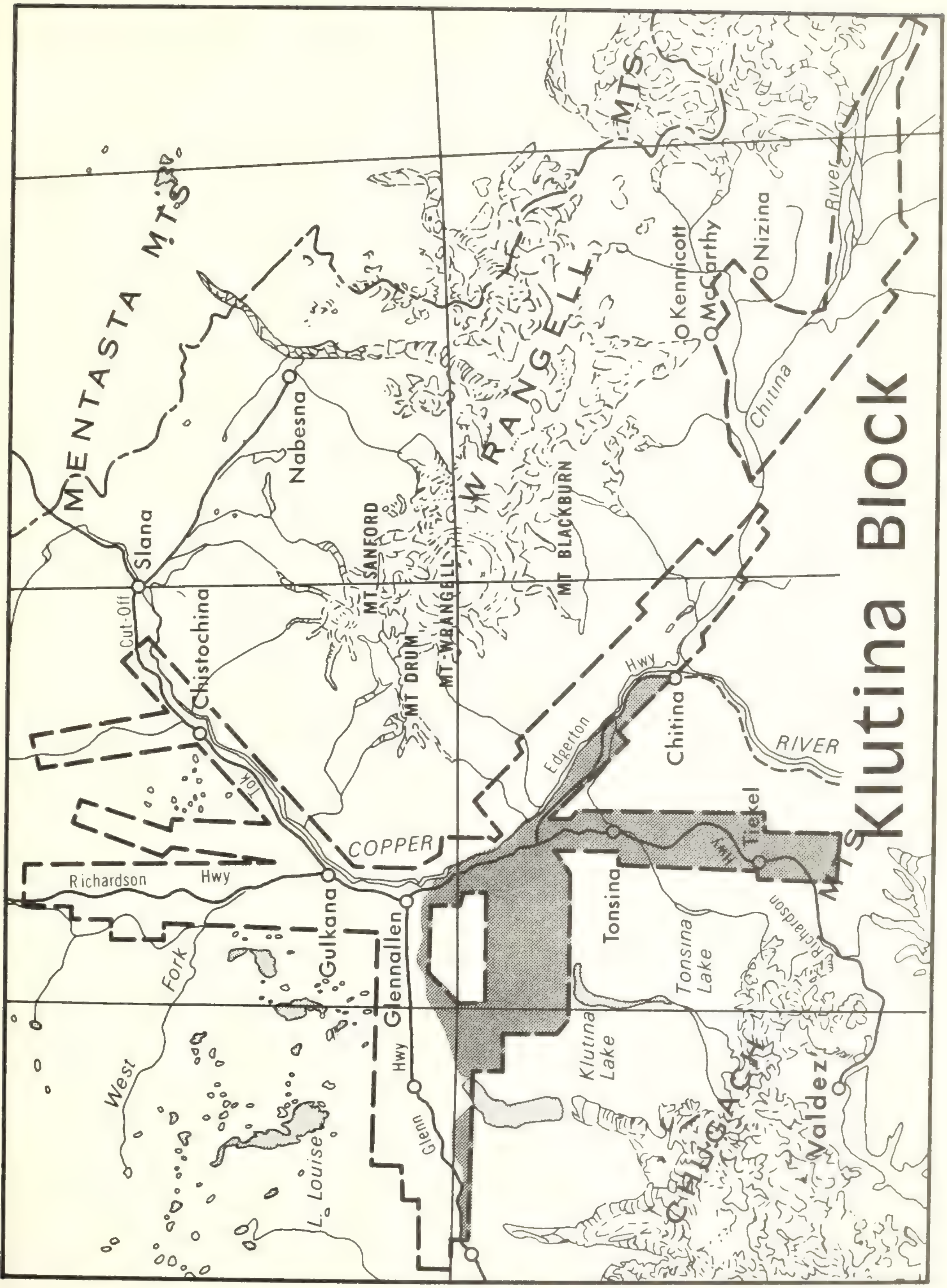
Species	Log grade[2]				
	1	2	3	4[3]	Total
Softwoods:					
White spruce	0	1.0	42.1	22.4	65.5
Total	0	1.0	42.1	22.4	65.5
Hardwoods:					
Balsam poplar	0	0	0	0	0
Paper birch	0	0	0	0	0
Quaking aspen	0	0	0	0	0
Total	0	0	0	0	0
All species	0	1.0	42.1	22.4	65.5

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

[2] Forest Products Laboratory. Hardwood log grades for standard lumber. USDA Forest Products Laboratory Report R1737, 61 p., 1959.

Northern Hemlock and Hardwood Manufacturers Association. Official grading rules for northern hardwood and softwood logs and tie cuts. Green Bay, Wisconsin, 12 p., 1959.

[3] Logs used locally.



Klutina Block

TABLE 42--*Area by productivity and land class, Klutina block, Copper River inventory unit, Alaska, 1968*

Land class	Thousand acres
Forest land:	
Commercial	115.5
Noncommercial:	
Operable[1]	42.9
Inoperable[2]	348.0
Total	506.4
Nonforest land[3]	104.9
Total land	611.3
Census water	21.6
Total area	632.9

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

[2] Inoperable noncommercial forest land has a gross volume of less than 800 cubic feet per acre.

[3] Includes 7,100 acres of noncensus water. Noncensus water is defined as bodies of water 1 to 40 acres in size and watercourses 120 feet to 1/8 mile in width.

TABLE 43--*Area of commercial and operable noncommercial forest land, by stand-size class, Klutina block, Copper River inventory unit, Alaska, 1968*

(Thousand acres)

Stand-size class	Forest land		
	Commercial	Operable noncommercial[1]	Total
Sawtimber stands	64.0	2.8	66.8
Poletimber stands	5.7	37.2	42.9
Seedling and sapling stands	43.0	2.9	45.9
Nonstocked areas	2.8	0	2.8
Total	115.5	42.9	158.4

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 44--*Area of commercial forest land by area condition class, Klutina block, Copper River inventory unit, Alaska, 1968*

Code	Area condition class	Thousand acres
10	Areas 100 percent or more stocked with desirable trees and not overstocked	0
20	Areas 100 percent or more stocked with desirable trees and overstocked	0
30	Areas 60 to 100 percent stocked with desirable trees, and with less than 30 percent of the area controlled by acceptable growing-stock trees, cull trees, inhibiting vegetation, slash, or nonstockable conditions	13.1
40	Areas to to 100 percent stocked with desirable trees and with 30 percent or more of the area controlled by other trees (or overstocked areas) or conditions that ordinarily prevent occupancy by desirable trees	5.8
50	Areas less than 60 percent stocked with desirable trees, but with 100-percent or more stocking with growing-stock trees	15.0
60	Areas less than 60 percent stocked with desirable trees, but with 60- to 100-percent stocking with growing-stock trees	57.9
70	Areas less than 60 percent stocked with desirable trees, and with less than 60-percent stocking with growing-stock trees	23.7
All classes		115.5

TABLE 45--*Area of commercial and noncommercial forest land, by forest type, Klutina block, Copper River inventory unit, Alaska, 1968*

(Thousand acres)

Forest type	Commercial forest land	Noncommercial forest land		
		Operable[1]	Inoperable[2]	Total
Balsam poplar	7.4	0	0	0
Black spruce	--	0	322.7	322.7
Paper birch	0	0	0	0
Quaking aspen	18.8	2.9	0	2.9
White spruce	86.4	40.0	25.3	65.3
Nonstocked	2.9	0	0	0
Total	115.5	42.9	348.0	390.9

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

[2] Inoperable noncommercial forest land has a gross volume of less than 800 cubic feet per acre. Most of the inoperable noncommercial forest land is assumed to be black spruce although other forest types, in addition to the 25,300 acres of white spruce, may be represented.

TABLE 46--*Net volume of timber on commercial and operable noncommercial forest land, by class of timber and softwoods and hardwoods, Klutina block, Copper River inventory unit, Alaska, 1968*

(Million cubic feet)

Class of timber	Commercial forest land			Operable noncommercial forest land[1]		
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total
Sawtimber trees:						
Saw-log portion	44.7	7.5	52.2	11.2	0	11.2
Upper-stem portion	13.3	.8	14.1	3.4	0	3.4
Total	58.0	8.3	66.3	14.6	0	14.6
Poletimber	22.7	9.4	32.1	29.9	5.0	34.9
All growing-stock trees	80.7	17.7	98.4	44.5	5.0	49.5
Rough trees	.6	.3	.9	.6	0	.6
Rotten trees	.9	.4	1.3	0	0	0
Salvable dead trees	.6	0	.6	0	0	0
Total	82.8	18.4	101.2	45.1	5.0	50.1

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 47--*Net volume of growing stock on commercial forest land by forest type and softwoods and hardwoods, Klutina block, Copper River inventory unit, Alaska, 1968*

(Thousand cubic feet)

Forest type	Softwoods	Hardwoods	Total
Balsam poplar	5,380.3	8,210.6	13,590.9
Quaking aspen	522.2	4,858.4	5,380.6
White spruce	74,832.2	4,658.3	79,490.5
Total	80,734.7	17,727.3	98,462.0

TABLE 48--*Net volume of growing stock on operable noncommercial*[1] *forest land by forest type and softwoods and hardwoods, Klutina block, Copper River inventory unit, Alaska, 1968*

(Thousand cubic feet)

Forest type	Softwoods	Hardwoods	Total
Black spruce	0	0	0
Quaking aspen	0	2,076.5	2,076.5
White spruce	44,444.4	2,895.0	47,339.4
Total	44,444.4	4,971.5	49,415.9

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 49--*Net volume of sawtimber on commercial forest land by forest type and softwoods and hardwoods, Klutina block, Copper River inventory unit, Alaska, 1968*

(Thousand board feet, International 1/4-inch rule)

Forest type	Softwoods	Hardwoods	Total
Balsam poplar	31,574.0	32,087.7	63,661.7
Quaking aspen	1,296.0	0	1,296.0
White spruce	306,318.9	6,426.2	312,745.1
Total	339,188.9	38,513.9	377,702.8

TABLE 50--*Net volume of sawtimber on operable noncommercial*[1] *forest land by forest type and softwoods and hardwoods, Klutina block, Copper River inventory unit, Alaska, 1968*

(Thousand board feet, International 1/4-inch rule)

Forest type	Softwoods	Hardwoods	Total
Black spruce	0	0	0
Quaking aspen	0	0	0
White spruce	86,795.3	0	86,795.3
Total	86,795.3	0	86,795.3

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 51--*Net volume of sawtimber on commercial forest land, by species and log grade, Klutina block, Copper River inventory unit, Alaska, 1968*

(Million board feet, International 1/4-inch rule)

Species	Log grade[1]				
	1	2	3	4[2]	Total
Softwoods:					
White spruce	0	13.6	248.5	77.1	339.2
Total	0	13.6	248.5	77.1	339.2
Hardwoods:					
Balsam poplar	12.0	13.9	5.8	2.4	34.1
Paper birch	0	0	0	0	0
Quaking aspen	0	0	1.6	2.8	4.4
Total	12.0	13.9	7.4	5.2	38.5
All species	12.0	27.5	255.9	82.3	377.7

[1] Forest Products Laboratory. Hardwood log grades for standard lumber. USDA Forest Products Laboratory Report R1737, 61 p., 1959.

Northern Hemlock and Hardwood Manufacturers Association. Official grading rules for northern hardwood and softwood logs and tie cuts. Green Bay, Wisconsin, 12 p., 1959.

[2] Logs used locally.

TABLE 52--*Net volume of sawtimber on operable noncommercial*[1] *forest land, by species and log grade, Klutina block, Copper River inventory unit, Alaska, 1968*

(Million board feet, International 1/4-inch rule)

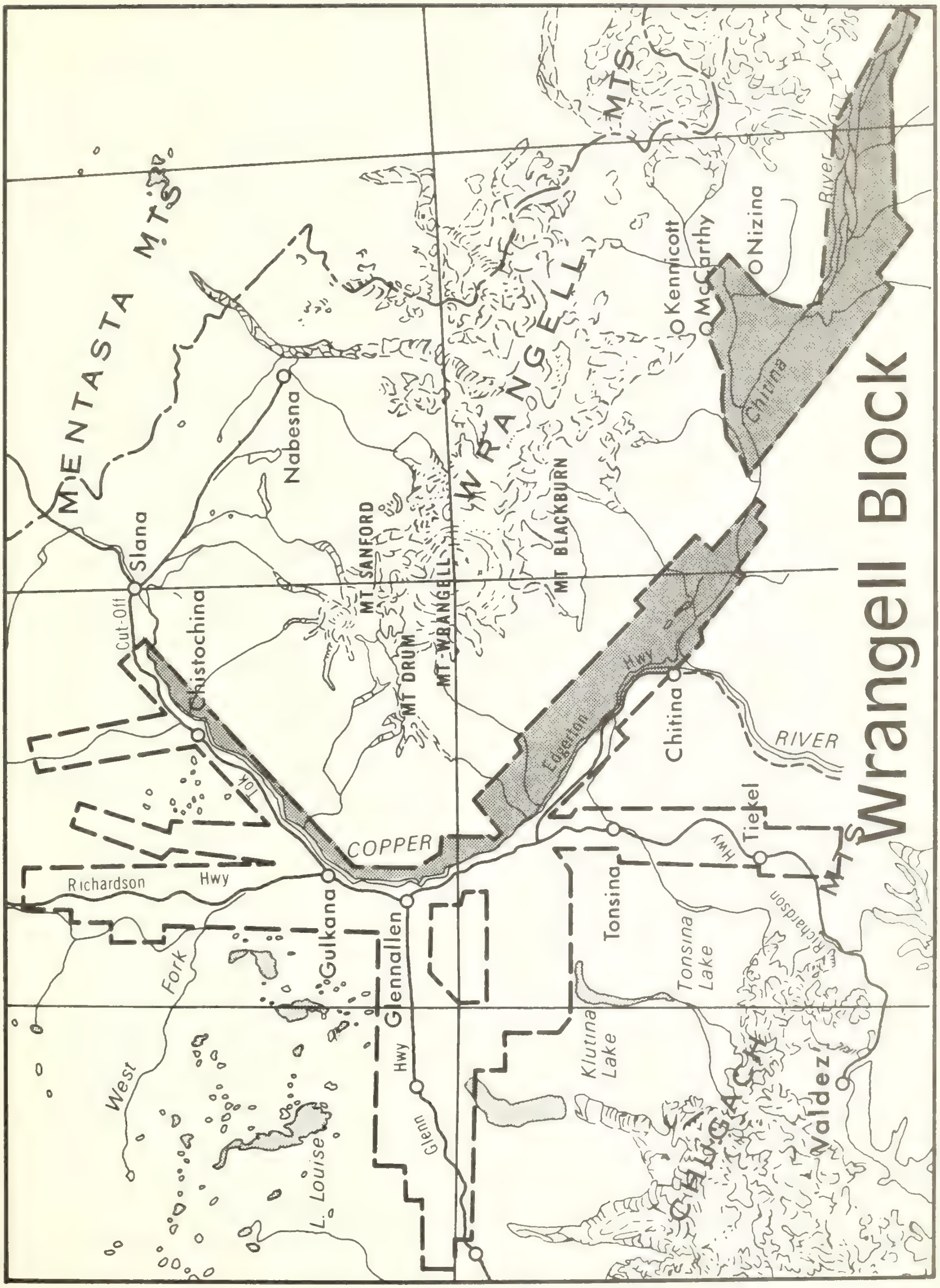
Species	Log grade[2]				
	1	2	3	4[3]	Total
Softwoods:					
White spruce	0	0	69.0	17.8	86.8
Total	0	0	69.0	17.8	86.8
Hardwoods:					
Balsam poplar	0	0	0	0	0
Paper birch	0	0	0	0	0
Quaking aspen	0	0	0	0	0
Total	0	0	0	0	0
All species	0	0	69.0	17.8	86.8

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

[2] Forest Products Laboratory. Hardwood log grades for standard lumber. USDA Forest Products Laboratory Report R1737, 61 p., 1959.

Northern Hemlock and Hardwood Manufacturers Association. Official grading rules for northern hardwood and softwood logs and tie cuts. Green Bay, Wisconsin, 12 p., 1959.

[3] Logs used locally.



Wrangell Block

TABLE 53--*Area by productivity and land class, Wrangell block, Copper River inventory unit, Alaska, 1968*

Land class	Thousand acres
Forest land:	
Commercial	133.2
Noncommercial:	
Operable[1]	83.2
Inoperable[2]	271.5
Total	487.9
Nonforest land[3]	43.8
Total land	531.7
Census water	68.3
Total area	600.0

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

[2] Inoperable noncommercial forest land has a gross volume of less than 800 cubic feet per acre.

[3] Includes 9,600 acres of noncensus water. Noncensus water is defined as bodies of water 1 to 40 acres in size and watercourses 120 feet to 1/8 mile in width.

TABLE 54--*Area of commercial and operable noncommercial forest land, by stand-size class, Wrangell block, Copper River inventory unit, Alaska, 1968*

(Thousand acres)

Stand-size class	Forest land		
	Commercial	Operable noncommercial[1]	Total
Sawtimber stands	77.7	54.5	132.2
Poletimber stands	14.7	28.7	43.4
Seedling and sapling stands	36.0	0.0	36.0
Nonstocked areas	4.8	0.0	4.8
Total	133.2	83.2	216.4

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 55-*Area of commercial forest land by area condition class, Wrangell block, Copper River inventory unit, Alaska, 1968*

Code	Area condition class	Thousand acres
10	Areas 100 percent or more stocked with desirable trees and not overstocked	9.1
20	Areas 100 percent or more stocked with desirable trees and overstocked	0
30	Areas 60 to 100 percent stocked with desirable trees, and with less than 30 percent of the area controlled by acceptable growing-stock trees, cull trees, inhibiting vegetation, slash, or nonstockable conditions.	7.2
40	Areas 60 to 100 percent stocked with desirable trees and with 30 percent or more of the area controlled by other trees (or overstocked areas) or conditions that ordinarily prevent occupancy by desirable trees.	14.7
50	Areas less than 60 percent stocked with desirable trees, but with 100-percent or more stocking with growing-stock trees	25.4
60	Areas less than 60 percent stocked with desirable trees, but with 60- to 100-percent stocking with growing-stock trees	55.4
70	Areas less than 60 percent stocked with desirable trees, and with less than 60-percent stocking with growing-stock trees	21.4
All classes		133.2

TABLE 56-*Area of commercial and noncommercial forest land, by forest type, Wrangell block, Copper River inventory unit, Alaska, 1968*

(Thousand acres)

Forest type	Commercial forest land	Noncommercial forest land		
		Operable[1]	Inoperable[2]	Total
Balsam poplar	2.4	0	0	0
Black spruce	--	5.8	271.5	277.3
Paper birch	0	0	0	0
Quaking aspen	18.5	2.5	0	2.5
White spruce	107.5	74.9	0	74.9
Nonstocked	4.8	0	0	0
Total	133.2	83.2	271.5	354.7

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

[2] Inoperable noncommercial forest land has a gross volume of less than 800 cubic feet per acre. All inoperable noncommercial forest land is assumed to be black spruce although other forest types may be represented.

TABLE 57--*Net volume of timber on commercial and operable noncommercial forest land, by class of timber and softwoods and hardwoods, Wrangell block, Copper River inventory unit, Alaska, 1968*

(Million cubic feet)

Class of timber	Commercial forest land			Operable noncommercial forest land[1]		
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total
Sawtimber trees:						
Saw-log portion	85.0	5.8	90.8	35.4	2.3	37.7
Upper-stem portion	25.3	.6	25.9	10.6	.3	10.9
Total	110.3	6.4	116.7	46.0	2.6	48.6
Poletimber trees	41.8	11.2	53.0	34.4	2.9	37.3
All growing-stock trees	152.1	17.6	169.7	80.4	5.5	85.9
Rough trees	1.3	.1	1.4	4.5	0	4.5
Rotten trees	2.1	.1	2.2	.8	.1	.9
Salvable dead trees	2.1	0	2.1	1.0	0	1.0
Total	157.6	17.8	175.4	86.7	5.6	92.3

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 58--*Net volume of growing stock on commercial forest land by forest type and softwoods and hardwoods, Wrangell block, Copper River inventory unit, Alaska, 1968*

(Thousand cubic feet)

Forest type	Softwoods	Hardwoods	Total
Balsam poplar	3,284.2	5,029.5	8,313.7
Quaking aspen	2,434.7	9,099.4	11,534.1
White spruce	146,393.5	3,425.6	149,819.1
Total	152,112.4	17,554.5	169,666.9

TABLE 59--*Net volume of growing stock on operable noncommercial*[1/] *forest land by forest type and softwoods and hardwoods, Wrangell block, Copper River inventory unit, Alaska, 1968*

(Thousand cubic feet)

Forest type	Softwoods	Hardwoods	Total
Black spruce	1,607.6	1,051.5	2,659.1
Quaking aspen	911.7	2,055.2	2,966.9
White spruce	77,831.1	2,389.1	80,220.2
Total	80,350.4	5,495.8	85,846.2

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 60--*Net volume of sawtimber on commercial forest land by forest type and softwoods and hardwoods, Wrangell block, Copper River inventory unit, Alaska, 1968*

(Thousand board feet, International 1/4-inch rule)

Forest type	Softwoods	Hardwoods	Total
Balsam poplar	18,471.3	18,453.8	36,925.1
Quaking aspen	11,349.9	7,255.1	18,605.0
White spruce	619,658.1	1,834.6	621,492.7
Total	649,479.3	27,543.5	677,022.8

TABLE 61--*Net volume of sawtimber on operable noncommercial*[1/] *forest land by forest type and softwoods and hardwoods, Wrangell block, Copper River inventory unit, Alaska, 1968*

(Thousand board feet, International 1/4-inch rule)

Forest type	Softwoods	Hardwoods	Total
Black spruce	8,366.6	2,350.8	10,717.4
Quaking aspen	4,567.8	6,085.5	10,653.3
White spruce	258,776.4	1,063.4	259,839.8
Total	271,710.8	9,499.7	281,210.5

[1/] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

TABLE 62--*Net volume of sawtimber on commercial forest land, by species and log grade, Wrangell block, Copper River inventory unit, Alaska, 1968*

(Million board feet, International 1/4-inch rule)

Species	Log grade[1/]				
	1	2	3	4[2/]	Total
Softwoods:					
White spruce	0	53.7	476.4	119.4	649.5
Total	0	53.7	476.4	119.4	649.5
Hardwoods:					
Balsam poplar	0	3.0	16.6	1.9	21.5
Paper birch	0	0	0	0	0
Quaking aspen	.6	1.4	3.2	.8	6.0
Total	.6	4.4	19.8	2.7	27.5
All species	.6	58.1	496.2	122.1	677.0

[1/] Forest Products Laboratory. Hardwood log grades for standard lumber. USDA Forest Products Laboratory Report R1737, 61 p., 1959.

Northern Hemlock and Hardwood Manufacturers Association. Official grading rules for northern hardwood and softwood logs and tie cuts. Green Bay, Wisconsin, 12 p., 1959.

[2/] Logs used locally.

TABLE 63--*Net volume of sawtimber on operable noncommercial*[1] *forest land, by species and log grade, Wrangell block, Copper River inventory unit, Alaska, 1968*

(Million board feet, International 1/4-inch rule)

Species	Log grade[2]				
	1	2	3	4[3]	Total
Softwoods:					
White spruce	0	1.4	215.5	54.8	271.7
Total	0	1.4	215.5	54.8	271.7
Hardwoods:					
Balsam poplar	0	0	.3	0	.3
Paper birch	0	0	.8	0	.8
Quaking aspen	0	5.0	3.1	.3	8.4
Total	0	5.0	4.2	.3	9.5
All species	0	6.4	219.7	55.1	281.2

[1] Operable noncommercial forest land has a gross volume of more than 800 cubic feet per acre.

[2] Forest Products Laboratory. Hardwood log grades for standard lumber. USDA Forest Products Laboratory Report R1737, 61 p., 1959.

Northern Hemlock and Hardwood Manufacturers Association. Official grading rules for northern hardwood and softwood logs and tie cuts. Green Bay, Wisconsin, 12 p., 1959.

[3] Logs used locally.

LITERATURE CITED

Bickford, C. A.
1952. The sampling design used in the forest survey of the Northeast. J. For. 50:290-293.

Bruce, Donald, and Francis X. Schumacher.
1950. Forest mensuration. 483 p. McGraw-Hill Book Co., New York.

Hegg, Karl M.
1970. Forest resources of the Susitna Valley, Alaska. USDA For. Serv. Resour. Bull. PNW-32, 42 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Hegg, Karl M.
1974. Forest statistics for the upper Koyukuk River, Alaska, 1971. USDA For. Serv. Resour. Bull. PNW-54, 26 p., illus. Pac. Northwest and Range Exp. Stn., Portland, Oreg.

Hegg, Karl M.
1975. Timber resource statistics for the Fairbanks block Tanana inventory unit, Alaska, 1970. USDA For. Serv. Resour. Bull. PNW-59, 36 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Hutchison, O. Keith.
1967. Alaska's forest resource. USDA For. Serv. Resour. Bull. PNW-19, 74 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Little, Elbert L., Jr.
1953. Check list of native and naturalized trees of the United States (including Alaska). U.S. Dep. Agric., Agric. Handb. No. 41, 472 p. Washington, D.C.

Zasada, John C., and Leslie A. Viereck.
1970. White spruce cone and seed production in interior Alaska, 1957-68. USDA For. Serv. Res. Note PNW-129, 11 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Hegg, Karl M.
1975. Timber resource statistics for the Copper River inventory unit, Alaska, 1968. USDA For. Serv. Resour. Bull. PNW-62, 55 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Presents forest conditions, regeneration, forest use, and sampling procedures of the first intensive forest inventory of the Copper River Valley in Alaska. Data are presented for commercial forest land and a special noncommercial forest-land class.

KEYWORDS: Forest surveys (interior Alaska), resources (forest).

Hegg, Karl M.
1975. Timber resource statistics for the Copper River inventory unit, Alaska, 1968. USDA For. Serv. Resour. Bull. PNW-62, 55 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Presents forest conditions, regeneration, forest use, and sampling procedures of the first intensive forest inventory of the Copper River Valley in Alaska. Data are presented for commercial forest land and a special noncommercial forest-land class.

KEYWORDS: Forest surveys (interior Alaska), resources (forest).

Hegg, Karl M.
1975. Timber resource statistics for the Copper River inventory unit, Alaska, 1968. USDA For. Serv. Resour. Bull. PNW-62, 55 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Presents forest conditions, regeneration, forest use, and sampling procedures for the first intensive forest inventory of the Copper River Valley in Alaska. Data are presented for commercial forest land and a special noncommercial forest-land class.

KEYWORDS: Forest surveys (interior Alaska), resources (forest).

Hegg, Karl M.
1975. Timber resource statistics for the Copper River inventory unit, Alaska, 1968. USDA For. Serv. Resour. Bull. PNW-62, 55 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Presents forest conditions, regeneration, forest use, and sampling procedures of the first intensive forest inventory of the Copper River Valley in Alaska. Data are presented for commercial forest land and a special noncommercial forest-land class.

KEYWORDS: Forest surveys (interior Alaska), resources (forest).

The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Developing and evaluating alternative methods and levels of resource management.
3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research are made available promptly. Project headquarters are at:

Fairbanks, Alaska
Juneau, Alaska
Bend, Oregon
Corvallis, Oregon
La Grande, Oregon
Portland, Oregon
Olympia, Washington
Seattle, Washington
Wenatchee, Washington

Mailing address: Pacific Northwest Forest and Range Experiment Station
P.O. Box 3141
Portland, Oregon 97208

GPO 994-744

The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

The U.S. Department of Agriculture is an Equal Opportunity Employer. Applicants for all Department programs will be given equal consideration without regard to race, color, sex or national origin.

A 13.78:PNW-3

USDA Forest Service
Resource Bulletin PNW-63 (Revised)

January 1976

CLEMSON UNIVERSITY LIBRARY
FEB 27 1976

1974 OREGON TIMBER HARVEST

by

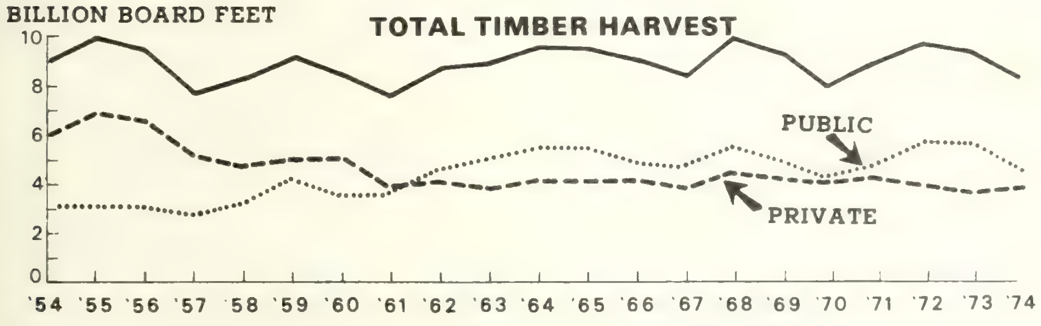
J. D. Lloyd, Jr., *Supervisory Forester*

The 1974 Oregon timber harvest of 8.36 billion board feet was 9.2 percent, or 0.84 billion board feet, below the 1973 harvest. (The data for 1973 were adjusted to reflect the change in reporting of harvest on Bureau of Land Management lands; see footnote 3 of table.) While the harvest in western Oregon decreased 14.7 percent, eastern Oregon cut increased 11.5 percent.

Timber harvest on all public lands decreased 18.9 percent, or 1.06 billion board feet, compared with 1973. Nearly all the decrease was in western Oregon where the harvest was down 23.6 percent, while the harvest in eastern Oregon decreased only 4.6 percent. Total harvest on National Forests decreased 17.5 percent and on Bureau of Land Management lands, 23.5 percent.

Total harvest on private lands increased 5.9 percent or 212 million board feet above the 1973 mark. In western Oregon, cut on forest industry lands increased 6.0 percent, or 150 million board feet, but decreased on other private lands 39.9 percent or 225 million board feet. On the east side, harvest increased on forest industry and other private lands, respectively, 31.6 percent (147 million board feet) and 150 percent (140 million board feet).

OREGON TIMBER HARVEST 1954-74



PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION

Robert F. Tarrant, Director
FOREST SERVICE

P.O. Box 3141 Portland, Oregon 97208
U.S. Department of Agriculture

Timber Harvest by Ownership in the State of Oregon, 1974[1]

(In thousands of board feet, Scribner log scale)

Half-State and county	Private[2]			Bureau of Land Management[3]	National Forest[4]	Indian[5]	Other Federal[2]	State[6]	Other public[2]	Total
	Forest industry	Other	Total							
Western Oregon:										
Benton	48,038	5,796	53,834	45,077	9,045	--	--	9,256	--	117,212
Clackamas	121,178	8,504	129,682	28,498	177,255	--	--	313	198	335,946
Clatsop	118,299	8,368	126,667	--	--	--	--	30,488	272	157,427
Columbia	57,481	12,796	70,277	464	--	--	--	1,228	114	72.083
Coos	268,871	24,217	293,088	125,108	30,529	--	--	61,883	7,260	517,868
Curry	80,101	5,170	85,271	16,259	99,607	--	--	5,434	--	206,571
Douglas	591,620	56,708	648,328	287,569	364,134	--	--	29,013	446	1,329,490
Hood River	7,732	108	7,840	--	33,438	--	--	--	2,959	44,237
Jackson	245,397	17,398	262,795	81,124	149,112	--	--	--	--	493,031
Josephine	7,660	5,312	12,972	70,566	55,880	--	--	2,710	3,071	145,199
Lane	401,893	94,314	496,207	162,891	610,623	--	--	3,317	246	1,273,284
Lincoln	96,423	3,660	100,083	23,927	116,161	--	--	16,014	--	256,185
Linn	337,529	66,794	404,323	59,731	190,953	--	--	10,669	--	665,676
Marion	9,492	5,398	14,890	6,073	44,871	--	--	4,983	--	70,817
Multnomah	3,106	2,640	5,746	--	48,910	--	--	--	--	54,656
Polk	57,699	3,704	61,403	20,872	--	--	--	497	--	82,772
Tillamook	140,973	4,982	145,955	40,495	44,114	--	--	31,876	--	262,440
Washington	25,965	6,927	32,892	--	--	--	--	8,169	--	41,061
Yamhill	15,946	6,387	22,333	31,168	9,870	--	--	--	520	63,891
Total	2,635,403	339,183	2,974,586	999,822	1,984,502	--	--	215,850	15,086	6,189,846
Eastern Oregon:										
Baker	10,884	15,328	26,212	--	28,393	--	--	--	--	54,605
Crook	7,163	640	7,803	--	77,886	--	--	--	--	85,689
Deschutes	6,090	--	6,090	--	85,780	--	--	--	--	91,870
Gilliam	--	--	--	--	--	--	--	--	--	--
Grant	37,354	39,050	76,404	4,223	258,395	--	--	--	--	339,022
Harney	9	93	102	--	50,870	--	--	--	--	50,972
Jefferson	3,222	--	3,222	--	33,653	27,103	--	--	--	63,978
Klamath	262,200	34,243	296,443	21,249	203,344	--	--	9,423	--	530,459
Lake	138,315	42,467	180,782	--	130,461	--	--	--	--	311,243
Malheur	--	--	--	--	--	--	--	--	--	--
Morrow	4,704	614	5,318	--	10,148	--	--	--	--	15,466
Sherman	--	--	--	--	--	--	--	--	--	--
Umatilla	17,804	13,754	31,558	--	42,213	--	--	--	--	73,771
Union	58,603	73,243	131,846	188	71,612	--	--	--	--	203,646
Wallowa	17,531	5,372	22,903	--	57,188	--	--	--	--	80,091
Wasco	20,394	4,355	24,749	--	75,509	83,474	--	--	--	183,732
Wheeler	29,661	4,689	34,350	6	52,655	--	--	--	--	87,011
Total	613,934	233,848	847,782	25,666	1,178,107	110,577	--	9,423	--	2,171,555
Total Oregon	3,249,337	573,031	3,822,368	1,025,488	3,162,609	110,577	--	225,273	15,086	8,361,401

---

[1] Includes volume removed as logs and poles and piling but not volume removed for woodcutting operations.

[2] Compiled by Oregon State Department of Revenue.

[3] Compiled by U.S. Bureau of Land Management in terms of short log scale. For this report, beginning with 1974, volumes for western Oregon are adjusted to long log by a factor of 0.89.

[4] Compiled by U.S. Forest Service, Region 6.

[5] Compiled by U.S. Bureau of Indian Affairs.

[6] Compiled by State Forester.

Prepared by Forest Survey Project, Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Portland, Oregon.

Keywords: Production statistics, Oregon.

USDA Forest Service Resource Bulletin PNW-64
1976

Economic Availability of Logging Residue in the Douglas-fir Region

GOVT. DOCUMENTS
DEPARTMENT
SEP
CLEMSON
LIBRARY

THOMAS C. ADAMS

CLEMSON UNIVERSITY LIBRARY
15 1976
SCI.

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
U.S. Department of Agriculture Forest Service Portland, Oregon

ECONOMIC AVAILABILITY OF LOGGING RESIDUE IN THE DOUGLAS-FIR REGION

Reference Abstract

Adams, Thomas C.
1976. Economic availability of logging residue in the Douglas-fir region. USDA For. Serv. Resour. Bull. PNW-64, 9 p.

Large amounts of logging residue are generated each year in timber harvest operations in old-growth forests in the Douglas-fir region of western Washington and western Oregon. Economic availability of each piece, however, depends on its size, condition, location, and on the existence of markets, with an adequate price to cover costs. An estimated 185.8 million cubic feet of logging residue were found to have a positive conversion value in 1970. Lack of utilization is considered due to numerous technical inefficiencies and market imperfections such as low volumes per acre, lack of local markets, general market instability, and problems of setting specifications, scaling, and pricing.

KEYWORDS: Slash utilization, marketing (forest products).

RESEARCH SUMMARY

Resource Bulletin PNW–64

1976

Timber harvest in old-growth forests in the Douglas-fir region of western Washington and western Oregon leaves large amounts of logging residue. This residue has been classified in a recent inventory according to diameter, length, percent soundness, ownership class, and type of material. Using volume and value recovery data from a sawmill study covering use of such material, conversion values for the different classes of logging residue were developed. These conversion values also took into account representative logging and hauling costs.

Cumulative amounts of residue were arrayed by value class. Values ranged from $18 to minus $49 per cunit (hundred cubic feet). An estimated 185.8 million cubic feet (5.26 million cubic meters) were found to have a positive conversion value, available for stumpage, profit, and risk. This volume comprised about half of the total residue volume considered potentially available. The positive conversion values were concentrated in the larger diameter, sounder pieces.

Lack of utilization of this material is believed due to the numerous technical inefficiencies and market imperfections for residue-type material. These include such factors as low volumes per acre, long distance to market, difficulties of setting specifications and determining logging costs or recovery values for such material, lack of a local market, scaling and pricing problems, and general market instability.

Introduction

Timber harvest in old-growth forests generally leaves a large amount of logging residue in the form of broken, rotten, or otherwise defective pieces, tops, and small logs or trees. This residue is receiving increasing attention as a potential source of raw material for the wood products industry or for other uses such as electric power generation.

Total amounts of logging residue are impressive, especially on old-growth clearcut areas in the Douglas-fir region of western Washington and western Oregon. Its economic availability depends on the size, condition, and location of each piece, on specific costs of logging and manufacture, and on the existence of markets, with an adequate price to cover costs.

This report, which focuses on economic availability, presents one approach to evaluating logging residue. It examines the different sizes and other characteristics of logging residue in western Washington and western Oregon and classifies this material according to value classes, taking into account differences in percent chippable class and costs of logging and manufacture for the different diameter classes.

Cumulative amounts of residue are arrayed by value class and shown graphically to provide information on aggregate amounts that are economically available with inclusion of each successive value class.

This report is based on inventory data from 1969 logging operations and on product recovery data from a 1970 sawmill study. Costs and values are estimated as of 1970. Although conditions have since changed, the classification and valuation according to economic availability should still be helpful in understanding the heterogeneous nature of logging residue and some of the problems of its utilization. The amount of residue left on the ground at any given time will depend heavily on the state of the pulp and paper and chip export markets, and on the proportion of the chip market supplied by mill residue from sawmills and plywood plants.

Results of this study will be of interest to those persons concerned about the problem of residue management and the long-term potential for increased residue utilization, as well as forest managers and forest industry personnel who make and implement decisions affecting residue utilization. Results will also be of interest to research workers concerned with methodology of quantifying and valuing a highly variable material.

Procedure and Results

INVENTORY OF LOGGING RESIDUE

The starting point in determining economic availability was the 1969 inventory of logging residue in Washington, Oregon, and California (Howard 1973). That survey included all material at least 4 inches in diameter and 4 feet long left on the ground after logging, from a sample survey of 76 logging operations, 54 of which were in western Washington and western Oregon.[1] It classified this material according to diameter, length, percent chippable class, geographic region, ownership class, and type of material. In the present study, these data were summarized by diameter and percent chippable classes (table 1).

---

[1] The inventory involved only 1969 clearcut operations in western Washington and western Oregon but sampled all types of logging operations elsewhere.

The inventory was then reduced to reflect practical utilization limits for the different classes of material covered by Howard's report. For example, that report included 77.5 million cubic feet of material classified as not mechanically debarkable. In the present study, only 10 percent of such nondebarkable material was considered potentially usable, assuming that hydraulic debarkers would be available only in a few limited locations, as at the present time, or that this amount could be used without debarking.[2] As a practical measure to simplify computations, all the material inventoried as slabs and splinters (40.6 million cubic feet) was assumed to be part of this material classified as not mechanically debarkable, even though it is recognized that some slabs and splinters would be debarkable.

Table 1--*Net volume of logging residue in western Washington and western Oregon, 1969*

Diameter class (inches)	Percent chippable class					
	1-20	21-40	41-60	61-80	81+	Total
	Million cubic feet[1]					
4.0 - 7.9	0.0	0.2	0.7	4.3	44.2	49.4
8.0 -11.9	([2])	.3	2.6	11.4	75.0	89.4
12.0 -15.9	.0	2.0	3.6	14.0	47.0	66.6
16.0 -19.9	.2	1.5	4.8	11.5	28.5	46.5
20.0 -23.9	.5	1.6	4.8	11.0	17.3	35.2
24.0 -27.9	.2	.8	2.2	7.1	10.7	21.0
28.0+	.7	10.7	15.8	28.7	55.6	111.6
Slabs and splinters	.4	1.6	6.5	13.5	18.4	40.6
Total	2.0	18.7	41.0	101.5	296.7	460.2

[1] Data may not add to totals because of rounding.

[2] Less than 0.1 million cubic feet.

Source: Developed from table 11 of Howard (1973).

---

[2] The 10-percent utilization factor is not definitive but intended as a rough recognition that most western mills have only mechanical debarkers and require logs that can produce clean chips. A change in mill technology could change this factor greatly.

In addition, only 90 percent each of inventoried breakage and hardwoods were considered potentially usable, the hardwoods for chipping only. This is to recognize that some of the most irregularly shaped of these, and the more widely scattered hardwoods, would not be used in a realistic time frame.

The resulting inventory of potentially usable residue material totals 375.7 million cubic feet (10.6 million cubic meters) (table 2).

CONVERSION VALUES[3]

Logging residue has a higher value when used for lumber or veneer products than for pulpwood chips. In good or average market periods, the majority of suitable veneer logs are recovered as either regular Peeler or Special Cull

Table 2--*Net volume of logging residue potentially available in western Washington and western Oregon, 1970*

Diameter class (inches)	Percent chippable class					
	1-20	21-40	41-60	61-80	81+	Total
	Million cubic feet[1]					
4.0 - 7.9	0	0.1	0.6	3.4	35.1	39.2
8.0 -11.9	(2/)	.2	2.1	9.1	59.5	71.0
12.0 -15.9	0	1.6	2.8	11.1	37.3	52.9
16.0 -19.9	.2	1.2	3.8	9.1	22.6	36.9
20.0 -23.9	.4	1.5	4.3	9.9	15.5	31.5
24.0 -27.9	.2	.7	2.0	6.3	9.6	18.7
28.0+	.7	9.6	14.1	25.7	49.8	99.9
	1.5	14.9	29.7	74.6	229.4	350.1
Hardwoods, usable, unclassified						25.6
Total						375.7

[1] Data may not add to totals because of rounding.

[2] Less than 0.1 million cubic feet.

Source: Data from table 1, less estimates for amounts of material not usable from hardwoods, breakage, and nondebarkable material.

---

[3] Conversion value is estimated mill sale recovery value less costs of logging, log hauling, and manufacturing. It is the margin available for stumpage and profit and risk.

grade logs.[4] Hence, for simplification, any additional amount of conversion to veneer products was not considered a significant part of the potential recovery mix from the logging residue inventory.

Since lumber recovery values are generally much higher than chip values, the recovery of lumber, wherever possible, is critical to a profitable outcome in most residue utilization efforts. In some cases, however, where lumber recovery is low and logs are difficult to handle, some residue might be more profitably processed into chips rather than lumber.

Unpublished data were available from a sawmill recovery study of mostly Utility grade logs,[5] from which were derived predicted dollar values of combined lumber and chip recovery for logs in combinations of 0 to 100 percent usable for lumber and 40 to 100 percent usable for chips, by 10-percentage classes.

Recovery amounts and conversion value of hogged fuel were also obtained from the above-mentioned sawmill recovery study. The conversion values in the mill study were derived from a compilation of actual sale recovery values, combined with estimates of costs of logging, hauling,[6] and manufacturing to give conversion values by log diameter class and percent chippable class (table 3). These conversion values show what could be paid for the residue. It should be noted that only the larger diameters, sounder volumes have a positive conversion value.

RESIDUE VOLUMES BY VALUE CLASS

The residue volumes of table 2 were combined with conversion values of table 3 to give total residue volumes, by value class (table 4). These tables show cumulative volumes by value class, used to construct the chart for economic availability of logging residue for the year 1970 (fig. 1).

Conversion values are also shown that take into account a profit margin, calculated as $9 per cunit.[7] These values were derived from analysis of profit margins used for appraisals in National Forest timber sales in Washington and Oregon for 1970. The reduced conversion values would apply to the extent that operators required at least the same profit margin for residue material as obtained in regular logging operations. Actually, with lower daily output for residue material, as compared to the larger, sounder material from regular logging, operators might require even higher profit margins when calculated as here on a unit volume basis.

---

[4] The Douglas-fir Special Cull grade includes logs that do not meet the requirements of Peeler and Sawmill grade rules but are suitable for rotary cutting, and have surface characteristics of a good No. 2 Sawmill log. In addition, they must have an adjusted gross diameter of at least 16 inches and adjusted gross length of 8 feet 8 inches and contain at least 60 percent usable material of firm white speck or better (Columbia River Log Scaling and Grading Bureau et al. 1972).

[5] This sawmill study was conducted at Kalama, Washington, in 1970. It included logs from 4 to 37 inches in diameter and from 0 to 100 percent sound for lumber or for chips. This operation sought to obtain maximum lumber recovery value from each log. Data of this study are on file at the Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

The Utility log grade includes logs that do not meet the requirements of Peeler or Sawmill grade logs but will produce not less than 50 percent of the gross volume in firm usable pulp chips. Minimum diameter is 6 inches and minimum length is 12 feet unless otherwise requested (Columbia River Log Scaling and Grading Bureau et al. 1972).

[6] An average hauling distance of 40 miles was used in this compilation.

[7] One cunit equals 100 cubic feet (2.83 cubic meters).

Table 3--*Estimated conversion value*[1] *of logging residue potentially available in western Washington and western Oregon, 1970*

Diameter class (inches)	Percent chippable class				
	1-20	21-40	41-60	61-80	81+
	Dollars per cunit[2]				
4.0 - 7.9	-54	-49	-45	-41	-37
8.0 -11.9	-52	-46	-40	-22	- 9
12.0 -15.9	-44	-37	-31	- 5	7
16.0 -19.9	-43	-29	-14	2	14
20.0 -23.9	-34	-24	-14	6	16
24.0 -27.9	-38	-25	-12	6	18
28.0+	-42	-29	-16	4	17
Hardwoods, usable, unclassified					-14

[1] Conversion value is estimated mill sale recovery value less costs of logging, log hauling, and manufacturing. It is the margin available for stumpage and profit and risk.

[2] 1 cunit equals 100 cubic feet (2.83 cubic meters).

Source: Developed from unpublished data on file at Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Also, the greater market instability and risk would further tend to require higher profit margins.

On a cubic-foot basis, conversion values ranged from $18 to minus $49 per cunit ($6.36 to minus $17.30 per cubic meter). Out of a total of 375.7 million cubic feet, 185.8 million or 49.4 percent had a calculated positive conversion value. With a $9 per cunit profit margin, however, only 97.5 million or 26.0 percent showed a calculated positive conversion value.

Table 4--*Cumulative net cubic volumes of logging residue, by conversion value class, western Washington and western Oregon, 1970*[1]

Conversion value per cunit[2]	Minus $9 margin for profit and risk	Residue volume	
		In class	Cumulative
Dollars		Million cubic feet	
18	9	9.6	9.6
17	8	49.8	59.4
16	7	15.5	74.9
14	5	22.6	97.5
7	-2	37.3	134.8
6	-3	16.2	151.0
4	-5	25.7	176.7
2	-7	9.1	185.8
-5	-14	11.1	196.9
-9	-18	59.5	256.4
-12	-21	2.0	258.4
-14	-23	33.7	292.1
-16	-25	14.1	306.2
-22	-31	9.1	315.3
-24	-33	1.5	316.8
-25	-34	.7	317.5
-29	-38	10.8	328.3
-31	-40	2.8	331.1
-34	-43	.4	331.5
-37	-46	36.7	368.2
-38	-47	.2	368.4
-40	-49	2.1	370.5
-41	-50	3.4	373.9
-42	-51	.7	374.6
-43	-52	.2	374.8
-45	-54	.6	375.4
-46	-55	.2	375.6
-49	-58	.1	375.7

---

[1] Conversion value is estimated mill sale recovery value less costs of logging, log hauling, and manufacturing. It is the margin available for stumpage and profit and risk.

[2] 1 cunit equals 100 cubic feet (2.83 cubic meters).

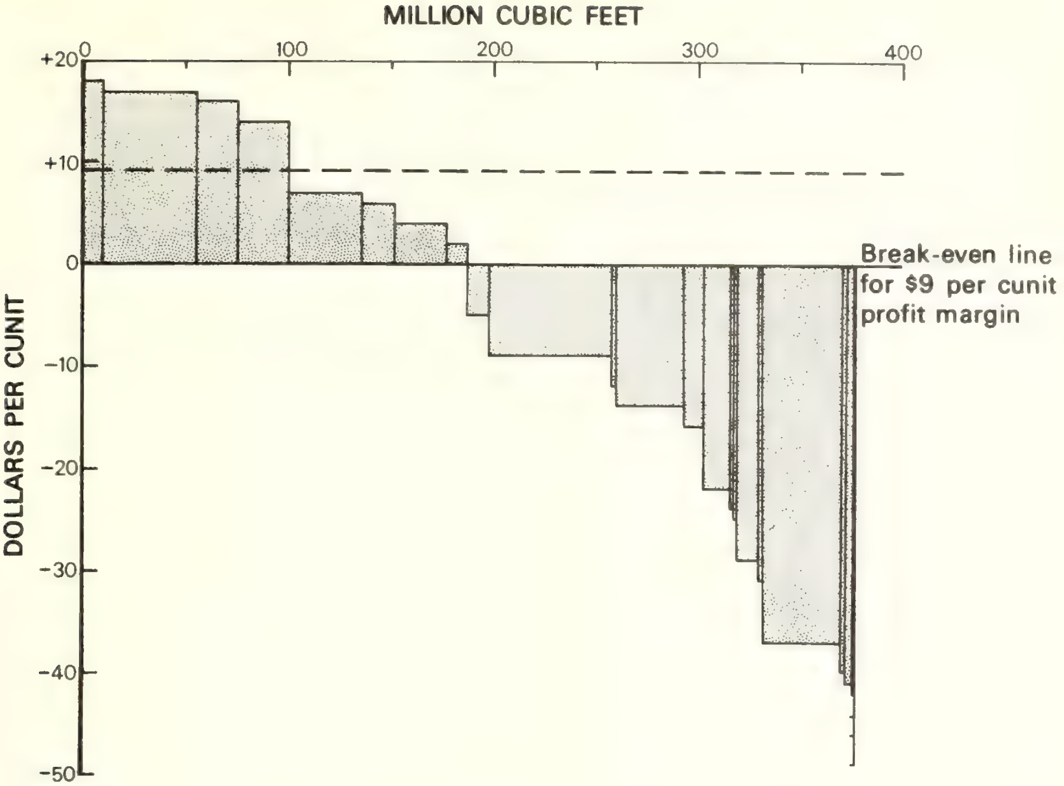


Figure 1.--Net volume of logging residue potentially available in western Washington and western Oregon, by conversion value, per cunit, 1970.

Discussion

Results show substantial volumes of logging residue economically available, even with the indicated profit margins. Why, then, was this material that had a positive conversion value not utilized? The answer lies in numerous technical inefficiencies of harvesting and manufacture, and market imperfections, such as:

1. Low volumes per acre, of widely scattered logging residue.
2. Long distance to market, beyond the 40-mile distance used in calculation of conversion values.
3. Practical difficulty of determining actual logging costs for residue-type material, and of relating estimated costs to a specific operating situation.
4. Difficulty of setting specifications for acceptable material, and of piece-by-piece inspection to weed out cull material.
5. Relatively high overall risk.
6. Lack of local market of mills willing to accept residue-type material.
7. Scaling and pricing problems in an unstable market.
8. Operator's lack of hauling equipment to accommodate mostly short pieces, especially pieces 4 to 8 feet in length.
9. No provision for residue in contract between timber sale purchaser and operator.
10. Risk that some pieces would be scaled and graded as merchantable logs, requiring stumpage payment at the full bid rate.

11. Lack of sorting facilities to separate Utility grade logs from other logs, either at the landing or at delivery point.
12. Payment to logging operator on the basis of net scale rather than gross scale.
13. Competitive pressure to keep net volume production at a high level.
14. Lack of local mills with whole log chipping capabilities.
15. Availability of better and more profitable logging opportunities elsewhere, and a psychological preference for working with sound material, rather than "junk."

Many of the above factors can be summed up in a general lack of enthusiasm for residue-type material by both loggers and mill operators. Moreover, at any given time and place, it is hard to force any additional residue onto existing mills, already supplied from other sources.

Another influence is the human factor: it takes time for people to change their established patterns of activity, even after they become aware of potential opportunities. Moreover, some persons react quickly to a new idea or procedure; others are by nature slow to adopt, or may prefer not to adopt at all (Zaltman 1965).

Enlargement of the total market for logging residue tends to come in spurts, chiefly as new chippers, log-handling facilities, hogged fuel boilers, or export facilities are installed in response to increased demand for chips or the other residue products. In addition, a major decrease in lumber output, as occurred in the winter of 1973-74, can reduce the flow of chipped sawmill residue so that pulpmills and chip export suppliers turn to more logging residue as a supplemental source.

The 1973-74 increased demand for Utility grade logs is reflected in average prices of Douglas-fir Utility grade logs rising from $27.70 per thousand board feet Scribner scale, in 1972 to $53.90 in 1974 (from $5.87 to $11.42 per cubic meter), and western hemlock logs of this grade rising from $36.10 per thousand board feet in 1972 to $68.30 in 1974 (from $7.65 to $14.47 per cubic meter).[8] Most of this price increase was due to the favorable chip market, which, became unfavorable generally in 1975.

In the long run, however, the positive market forces are bound to work themselves out to bring greater residue utilization. Stated differently, this means greater logging utilization will leave less residue in the first place.

Empirical studies are not conclusive, but these market forces can probably be encouraged by such means as YUM yarding (required yarding of unutilized material) and per-acre pricing for small, sound logs and for Utility grade or Cull logs of any size (Hamilton et al. 1975). These timber sales arrangements tend to lower the direct cost of residue-type material and in theory should make it economically more attractive, because there is no direct stumpage charge related to volume removed, and because YUM yarding costs are fixed costs borne by the sale as a whole. Such pricing arrangements are currently in effect in many timber sales on public forest lands, especially the National Forests.

---

[8] Developed from Industrial Forestry Association composite log price data (Industrial Forestry Association 1975).

Conclusions

Favorable opportunities are developing for major expansion into logging residue as a source of raw material, especially as time goes on and the forest industries gear up to more efficient use of this material. This is from a long-term point of view. Experience of the 1973-75 period shows that current economic conditions at any given point in time strongly influence the profitability of removing logging residue, and wide fluctuations in logging utilization can occur, both upward and downward. Technical inefficiencies in harvesting and manufacturing and marketing imperfections may hold back utilization of logging residues even when positive values are present.

Residue utilization will be chiefly for pulpwood chips, together with any higher value products in the form of lumber or veneer that can be produced from residue. However, aggregate amounts are misleading, and the potential value of logging residue, either positive or negative, can only be determined for specific situations with respect to type of residue, location, sale arrangements, and development of suitable processing facilities.

Literature Cited

Columbia River, Grays Harbor, Northern California, Puget Sound, Southern Oregon, and Willapa Harbor Log Scaling and Grading Bureaus.
1972. Official log scaling and grading rules. 60 p., Eugene, Oreg.

Hamilton, Thomas E., James O. Howard, and Thomas C. Adams.
1975. Per-acre pricing--its effect on logging residue. USDA For. Serv. Res. Pap. PNW-192, 7 p. Pac. Northwest For. & Range Exp. Stn., Portland, Oreg.

Howard, James O.
1973. Logging residue in Washington, Oregon, and California--volume and characteristics. USDA For. Serv. Resour. Bull. PNW-44, 26 p., illus. Pac. Northwest For. & Range Exp. Stn., Portland, Oreg.

Industrial Forestry Association.
1975. Composite log sales analysis reports, for calendar year 1974 and earlier years. Ind. For. Assoc., Portland, Oreg.

Zaltman, Gerald.
1965. Marketing: contributions from the behavioral sciences. 163 p., illus. Harcourt, Brace & World, Inc., New York, N. Y.

Adams, Thomas C.
1976. **Economic availability of logging residue in the Douglas-fir region.** USDA For. Serv. Resour. Bull. PNW-64, 9 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Large amounts of logging residue are generated each year in timber harvest operations in old-growth forests in the Douglas-fir region of western Washington and western Oregon. Economic availability of each piece, however, depends on its size, condition, location, and on the existence of markets, with an adequate price to cover costs. An estimated 185.8 million cubic feet of logging residue were found to have a positive conversion value in 1970. Lack of utilization is considered due to numerous technical inefficiencies and market imperfections such as low volumes per acre, lack of local markets, general market instability, and problems of setting specifications, scaling, and pricing.

KEYWORDS: Slash utilization, marketing (forest products).

Adams, Thomas C.
1976. Economic availability of logging residue in the Douglas-fir region, USDA For. Serv. Resour. Bull. PNW-64, 9 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Large amounts of logging residue are generated each year in timber harvest operations in old-growth forests in the Douglas-fir region of western Washington and western Oregon. Economic availability of each piece, however, depends on its size, condition, location, and on the existence of markets, with an adequate price to cover costs. An estimated 185.8 million cubic feet of logging residue were found to have a positive conversion value in 1970. Lack of utilization is considered due to numerous technical inefficiencies and market imperfections such as low volumes per acre, lack of local markets, general market instability, and problems of setting specifications, scaling, and pricing.

KEYWORDS: Slash utilization, marketing (forest products).

Adams, Thomas C.
1976. Economic availability of logging residue in the Douglas-fir region. USDA For. Serv. Resour. Bull. PNW-64, 9 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Large amounts of logging residue are generated each year in timber harvest operations in old-growth forests in the Douglas-fir region of western Washington and western Oregon. Economic availability of each piece, however, depends on its size, condition, location, and on the existence of markets, with an adequate price to cover costs. An estimated 185.8 million cubic feet of logging residue were found to have a positive conversion value in 1970. Lack of utilization is considered due to numerous technical inefficiencies and market imperfections such as low volumes per acre, lack of local markets, general market instability, and problems of setting specifications, scaling, and pricing.

KEYWORDS: Slash utilization, marketing (forest products).

Adams, Thomas C.
1976. Economic availability of logging residue in the Douglas-fir region. USDA For. Serv. Resour. Bull. PNW-64, 9 p., iillus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Large amounts of logging residue are generated each year in timber harvest operations in old-growth forests in the Douglas-fir region of western Washington and western Oregon. Economic availability of each piece, however, depends on its size, condition, location, and on the existence of markets, with an adequate price to cover costs. An estimated 185.8 million cubic feet of logging residue were found to have a positive conversion value in 1970. Lack of utilization is considered due to numerous technical inefficiencies and market imperfections such as low volumes per acre, lack of local markets, general market instability, and problems of setting specifications, scaling, and pricing.

KEYWORDS: Slash utilization, marketing (forest products).

The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Developing and evaluating alternative methods and levels of resource management.
3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research are made available promptly. Project headquarters are at:

Fairbanks, Alaska
Juneau, Alaska
Bend, Oregon
Corvallis, Oregon
La Grande, Oregon
Portland, Oregon
Olympia, Washington
Seattle, Washington
Wenatchee, Washington

Mailing address: Pacific Northwest Forest and Range
Experiment Station
P.O. Box 3141
Portland, Oregon 97208

GPO 996-275

The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

The U.S. Department of Agriculture is an Equal Opportunity Employer. Applicants for all Department programs will be given equal consideration without regard to race, color, sex or national origin.

13.66: PNW-65

1976

USDA FOREST SERVICE RESOURCE BULLETIN PNW-65

TIMBER RESOURCES OF NORTHERN INTERIOR CALIFORNIA 1970

Charles L. Bolsinger

PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
PORTLAND, OREGON

Renewable resources evaluation research is a nationwide project of the Forest Service authorized by the McSweeney-McNary Forest Research Act of 1928 and subsequent amendments, and the Renewable Resources Planning Act of 1974 (Public Law 93-378). The purposes of renewable resources evaluation research are to inventory and evaluate the current amount, condition, and output from renewable resources on forests and rangelands and assess future trends in supply of and demand on these resources as a basis for formulating policies and programs. Resurveys are made periodically to update basic information.

Renewable Resources Evaluation Surveys are conducted throughout the 50 States by the U.S. Forest Service Experiment Stations. The Pacific Northwest Forest and Range Experiment Station at Portland, Oregon, is responsible for the States of Alaska, California, Hawaii, Oregon, and Washington.

Acknowledgments

The gathering and preparation of the timber resource information in this report has been a long, involved process requiring the cooperation of many people.

Regions 5 and 6 of the Forest Service, U.S. Department of Agriculture, supplied field plot data for National Forest lands. County tax assessors furnished ownership information for lands outside National Forests. The California Division of Forestry provided maps and timber production data. Other public agencies and many private landowners cooperated by permitting forest inventory crews to enter or cross lands and provided maps, aerial photographs, and other useful information.

The Renewable Resources Evaluation Research project of the Pacific Northwest Forest and Range Experiment Station gathered and processed all information from lands outside National Forests, processed the information supplied by the National Forests, and prepared this report. Thousands of man-days were required, including the time of:

Melvin E. Metcalf, Project Leader
Donald R. Gedney, Resource Analyst
John M. Berger, Compilation Supervisor
Charles L. Bolsinger, Field Supervisor, Report Author
Hal A. Arbogast, Dale Baer, J.D. Lloyd, Jr., Jon Wagy, and Steven O. Macica, Assistant Field Supervisors

Field crew

Richard Allen
Lonnie Baker
Steven Bush
Tom Catchpole
Sam Coe
Tom Eckman
John Emerson
Gary Findlay
Steve Gilliland
Randy Graboyes
Terry Graham
Don Hilt
David Kimmel
Timothy Krohn
Lyle Kuchenbecker
William Morrisson
Tharon O'Dell
William Ogden
Dale Okada
James Okraszewski
Robert Parks
Patrick Reece
Craig Stinebrink
Art Tasker
Paul Thorp
Jon Wagy
Dale Wilhelmi

Office personnel

Patricia Bassett
Grace Begay
Linda Brown
Ardella DeVan
Jill Hoopes
David M. Jacobs
Mary Anne Mei
Stan Ness
Fay Page
Marian Simons
John Teply
Susan Weaver
Kathleen Wutzke

TIMBER RESOURCES OF NORTHERN INTERIOR CALIFORNIA, 1970

Reference Abstract

Bolsinger, Charles L.
1976. Timber resources of Northern Interior California, 1970. USDA For. Serv. Resour. Bull. PNW-65, 75 p., illus.

This report summarizes a timber resource inventory in Lassen, Modoc, Siskiyou, Shasta, and Trinity Counties, California. Included are detailed tables of forest area, timber volume, growth, mortality, and removals and a discussion of the current timber resource and timber industry situation.

Keywords: Forest surveys (North Central California), resources (forest), statistics (forest).

RESEARCH SUMMARY

Resource Bulletin PNW-65

1976

California's Northern Interior (Lassen, Modoc, Siskiyou, Shasta, and Trinity Counties) has a relatively sparse population and extremely diverse climate, topography, soils, and vegetation.

Forest industries provide about 25 percent of the employment in the five-county area. Currently there are over 40 wood products mills, including lumber mills, veneer and plywood plants, pulp and board plants, and a post, pole, and piling installation. The trend since the 1940's has been toward fewer and larger mills. Lumber production dominates, though veneer and plywood have increased.

The area contains about 9.6 million acres of forest land, of which 6.0 million is classified as commercial, 3.2 million as unproductive, and 0.4 million acres as productive reserved in Parks and Wilderness. Public agencies own 60 percent of the commercial forest; 40 percent is privately owned. About 26 percent of public and 18 percent of private commercial forest land are expected to yield little timber in the future due to economic and environmental constraints and ownership objectives.

Since 1953, about 80,000 acres of commercial forest have been converted to roads, reservoirs, powerlines, grazing lands, residential and recreational developments, and other permanent clearings; 355,000 acres were reclassified from commercial to noncommercial. Recently developed methods of determining productivity were used as well as several

years of experience in problem areas such as some of the nonstocked burns. About 16,000 acres of National Forest land formerly classified as reserved were placed in the commercial forest category.

Ownership changes of commercial forest land include an increase in National Forest and forest industry land, and a decrease in other public and miscellaneous private holdings.

Douglas-fir, ponderosa pine, and true firs are the most common types. Most forest lands are fairly well stocked with trees; but the condition of many cutover stands, especially on private lands, is poor, resulting in lower growth rates and higher mortality than would be expected in well-managed forests.

Total volume in growing stock and sawtimber trees in 1970 is estimated at 15.9 billion cubic feet or 86.0 billion board feet (International 1/4-inch rule). National Forests own 70 percent of this, other public agencies 2 percent, and private landowners 28 percent.

Since 1953, standing timber volume has declined about 21 percent—17 percent on public lands and 45 percent on private lands. Pines and Douglas-fir are declining more rapidly than other species.

Total net annual growth is about 0.25 billion cubic feet or 1.25 billion board feet. National Forest lands account for 63 percent of the cubic-foot growth and have the highest per-acre growth rate (45 cubic feet per acre). Private lands, though potentially more productive than National Forest lands, have a lower current growth rate (34 cubic feet per acre on forest industry land, 37 cubic feet on other private). Annual mortality is about 45 million cubic feet or 222 million board feet. National Forests have the lowest mortality rate relative to inventory volume. The lower per-acre growth and higher mortality rates on private lands are due primarily to the poor condition of the logged and burned areas, which amount to about 75 percent of these private ownerships. Growth has been increasing, however, and there are reasons to expect better performance in the future.

Salvable dead timber volume is nearly equal to the annual timber cut, but much of this can not be salvaged economically.

The annual timber cut has remained fairly constant for the past 20 years, ranging between 1.3 and 1.5 billion board feet; but there has been a decided shift from private to public timber and from the eastern part of the area to the west. The annual cut apparently could be maintained indefinitely at 1.3 billion board feet if the average annual growth could be increased from 173 board feet per acre to 216 (or from about 40 cubic feet to 50). This seems possible, biologically; but it would require more intensive forestry and for some ownerships a change in management objectives.

PREFACE

Numerous reports on the timber resources of California have been published, beginning with a section in Charles S. Sargent's "Report on the Forests of North America (exclusive of Mexico)" in 1880; but not until the late 1940's was a comprehensive field inventory made. In 1954 USDA Forest Service Forest Survey Release No. 25, "Forest Statistics for California," was published. This report included forest area data by county and public and private ownerships and timber volume by subregions of the State. The volume data for the 1954 report were collected on 1,527 commercial forest plots established throughout the State. Individual reports for Siskiyou (1950), Shasta (1954), and Trinity (1951) Counties that showed forest area detail, but no volume figures, were also published from some of the same data used in Release No. 25.

The results of a reinventory of California forest resources in 1962 were published in Resource Bulletin PSW-4, "Commercial Forest Area and Timber Volume in California, 1963" (Oswald and Hornibrook 1966). The reinventory consisted of a remeasurement of about 15 percent of the 1,527 plots established for the 1950-54 inventory. The information was not developed by county.

The report you are reading summarizes the latest timber resource inventory in Lassen, Modoc, Siskiyou, Shasta, and Trinity Counties, California. A total of 1,859 commercial forest plots were established in the five-county area. These plots were selected from a much larger number of aerial photo plots—43,885 aerial photo plots were examined, including plots in commercial and noncommercial forest and nonforest areas. (See "Inventory Procedures," page 72, for details.)

Forests have played a prominent role in the socioeconomic scene during the past 125 years and will continue to be important to the people in the five-county area, as well as to the State and the Nation. This report is a point-in-time examination of the ever-changing forest resource. Though focusing primarily on the timber resources of the forests, that is, the amount and kind of wood available to meet people's needs, the information presented here may also be useful to people concerned with other resources of the forest, including grazing, water, clean air, wildlife, and recreation.

CONTENTS

Page

THE SETTING 1

THE FOREST INDUSTRY 9

FOREST AREA 11
  Ownership 11
  Forest Types 16
  Stand Size and Age 18
  Forest Land Productivity 20
  Stocking Condition 21
  Changes in Forest Land Area 23
  Ownership Changes 27

TIMBER VOLUME 28

FOREST GROWTH AND MORTALITY 30

SALVABLE DEAD TIMBER 36

TIMBER CUT 37

LITERATURE CITED 41

REFERENCES 42

TABLES 43

APPENDIX 67
  Metric Conversions 67
  Reliability of Forest Resource Estimates 68
  Woody Plants of Northern Interior Forests 69
  Inventory Procedures 72
  Definition of Terms 73

LIST OF TABLES

Page

1. Number of mills and percent of log consumption, by industry in California's Northern Interior for selected years, 1946-72 9
2. Growth and mortality by ownership, California's Northern Interior, 1970 32
3. Volume of salvable dead timber by species on National Forest and other public and private lands, California's Northern Interior, January 1, 1970 37
4. Area by land class and county, California's Northern Interior, January 1, 1970 44
5. Area of commercial forest land, by ownership class and county, California's Northern Interior, January 1, 1970 44
6. Area of commercial forest land, by ownership and stand-size classes, California's Northern Interior, January 1, 1970 45
7. Area of commercial forest land, by ownership and cubic-foot site classes, California's Northern Interior, January 1, 1970 45
8. Area of commercial forest land by stocking class of all growing-stock trees and ownership class, California's Northern Interior, January 1, 1970 46
9. Area of commercial forest land, by forest type and ownership class, California's Northern Interior, January 1, 1970 46
10. Area of noncommercial forest land by ownership class and forest type and land class, California's Northern Interior, January 1, 1970 47
11. Area of commercial forest land and volume of growing stock and sawtimber, by stand-age and ownership classes, California's Northern Interior, January 1, 1970 48
12. Net volume of growing stock and sawtimber on commercial forest land, by ownership class and by softwoods and hardwoods, California's Northern Interior, January 1, 1970 49
13. Net volume of growing stock and sawtimber on commercial forest land by county and ownership class, California's Northern Interior, January 1, 1970 50
14. Net volume of growing stock and sawtimber on commercial forest land, by stand-size class and by softwoods and hardwoods, California's Northern Interior, January 1, 1970 51
15. Net volume of growing stock on commercial forest land, by species and diameter class, California's Northern Interior, January 1, 1970 52
16. Net volume of sawtimber on commercial forest land, by species and diameter class, California's Northern Interior, January 1, 1970 (International 1/4-inch rule) 53
17. Net volume of sawtimber on commercial forest land, by species and diameter class, California's Northern Interior, January 1, 1970 (Scribner rule) 54
18. Net volume of growing stock on commercial forest land by species and ownership class, California's Northern Interior, January 1, 1970 55
19. Net volume of sawtimber on commercial forest land, by species and ownership class, California's Northern Interior, January 1, 1970 (International 1/4-inch rule) .56
20. Net volume of sawtimber on commercial forest land, by species and ownership class, California's Northern Interior, January 1, 1970 (Scribner rule) 57

LIST OF TABLES (continued)

21. Net annual growth of growing stock and sawtimber on commercial forest land, by ownership class and by softwoods and hardwoods, California's Northern Interior, 1970 5
22. Net annual growth of growing stock on commercial forest land, by species and ownership class, California's Northern Interior, 1970. 5
23. Net annual growth of sawtimber on commercial forest land, by species and ownership class, California's Northern Interior, 1970 (International 1/4-inch rule) . 6
24. Net annual growth of sawtimber on commercial forest land, by species and ownership class, California's Northern Interior, 1970 (Scribner rule) 6
25. Average annual mortality of growing stock on commercial forest land, by species and ownership class, California's Northern Interior, 1970 6
26. Average annual mortality of growing stock on commercial forest land, by species and ownership class, California's Northern Interior, 1970 (International 1/4-inch rule 6
27. Average annual mortality of growing stock on commercial forest land, by species and ownership class, California's Northern Interior, 1970 (Scribner rule) 6
28. Reported timber production by county in California's Northern Interior and all of California, 1946-73 6
29. Sampling errors of estimate of forest area and timber volume, California's Northern Interior, January 1, 1970 6
30. Approximate sampling error by size of estimate, California's Northern Interior, January 1, 1970 6

THE SETTING

California's Northern Interior is sparsely populated, having about 14 percent of the total land area in California but less than 1 percent of the population. The population density for the five-county area is 6.4 persons per square mile; but over half of the people live in Shasta County, mostly in and near Redding, the largest city in the area. Other major towns and cities are Susanville, Yreka, Alturas, Weaverville, and Weed.

Between 1960 and 1970, the population of the five-county area increased 14 percent compared with 27 percent for the entire State. The increase was essentially all in Shasta and Lassen Counties. Siskiyou County's population increased only 1 percent, Modoc County decreased 11 percent, and Trinity County decreased 22 percent.

The area is rather remote from California's population centers. Redding is 167 miles from Sacramento and 231 miles from San Francisco. Modoc County is one of the remotest areas in the State; Alturas, the county seat, is 312 miles from Sacramento and 379 miles from San Francisco.

The five-county area is extremely diverse in climate, topography, soils, and vegetation. The rugged Coast Ranges and Klamath Mountains (fig. 1) occupy the western portion of this

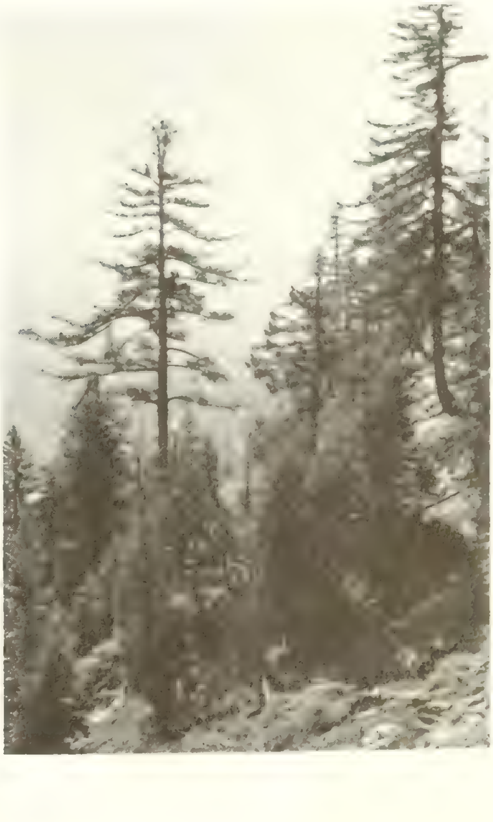


Figure 1.—The Coast Ranges and Klamath Mountains in the western part of the Northern Interior are heavily timbered, but many areas are difficult to manage due to steepness and rockiness.

area, with peaks up to 9,038 feet high and deep, narrow canyons cutting down to 400-500 feet along the Humboldt County line in Siskiyou and Trinity Counties. The southern Cascade Range occupies most of the eastern portion of the area where the 4,000- to 6,000-foot plateaus and rolling uplands are broken by occasional canyons and dotted by numerous volcanic peaks, including 14,162-foot Mount Shasta (fig. 2) and 10,466-foot Lassen Peak. The Warner Mountains in the extreme northeastern corner of the area are narrow and abrupt, a block-fault range with peaks up to 9,934 feet. The Sacramento River heads in the Northern Interior, and the northern tip of the Sacramento Valley separates the Coast Ranges from the Cascades in southern Shasta County. The east slopes of the Cascades grade into the arid Great Basin in eastern Lassen County.

The climate is variable because of the mountains which affect temperature and modify the moisture-laden westerly winds. Precipitation ranges from 50-60 inches or more in the western Siskiyou and Trinity Counties and in some of the higher mountains in Shasta County to less than 10 inches in extreme eastern Lassen and Modoc Counties and also in the Klamath-Tule Lake area in northeastern Siskiyou and northwestern Modoc Counties. The

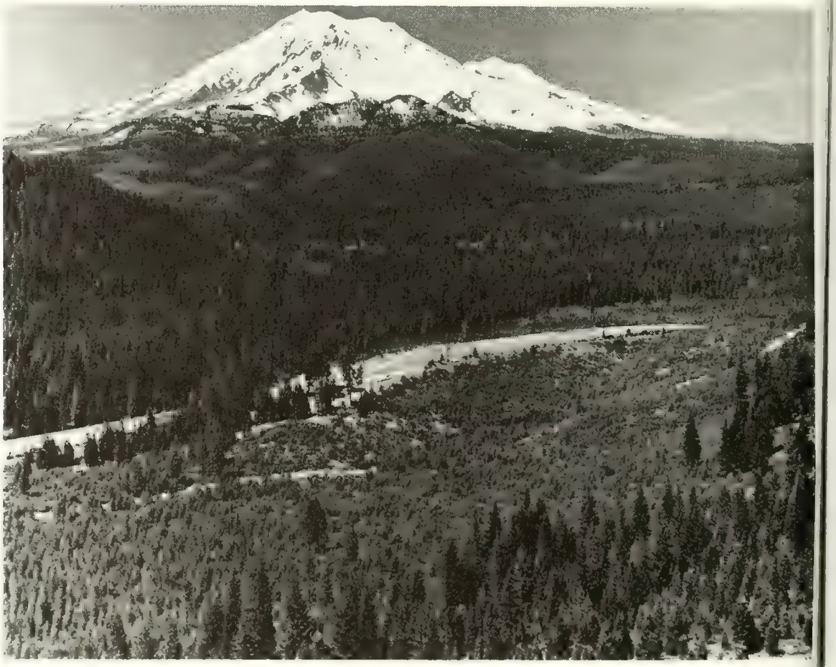


Figure 2.—Mount Shasta in southern Siskiyou County. The forests near timberline are primarily Shasta red fir and white fir; lower slopes in the picture are forested with mixed-conifer stands of Douglas-fir, white fir, ponderosa and sugar pines, and incense-cedar, with scattered stands of lodgepole pine on some burned areas. The smooth-textured gray patches are brushfields in burned areas that have not reforested.

frost-free period ranges from nearly 8 months in the Sacramento Valley in Shasta County to less than 3 months in the higher mountains in Lassen and Modoc Counties and 4 to 5 months in much of Trinity and western Siskiyou Counties.

Soils are extremely variable due to the diversity of the climate and parent material. Very productive soils derived from volcanic and metamorphic rocks are common in the Northern Interior, but in some areas there are soils derived from granite, peridotite or serpentine (fig. 3), and limestone, which are relatively low in productivity. Some soils on steep slopes, especially those derived from granite and metamorphic rocks, are extremely unstable (fig. 4) and cause logging, roadbuilding, and forest management problems.

Natural vegetation reflects the topography, climate, and soils and ranges from grassland and oak-savannah in the Sacramento Valley, through chaparral, Digger pine, and broadleaf woodland (fig. 5) in the foothills of both the Coast Ranges and Cascades, to forests of ponderosa pine, mixed conifers, and high elevation forests of true firs. Jeffrey pine occurs on peridotite/serpentine areas throughout the forested area and in mixed stands of other species on volcanic soils in the eastern portion of the area. On the lower eastern slopes of the Cascades, ponderosa-Jeffrey pine forests grade into sagebrush steppe, often intermixed with juniper, mountain-mahogany, and scrub black oak along the forest fringe

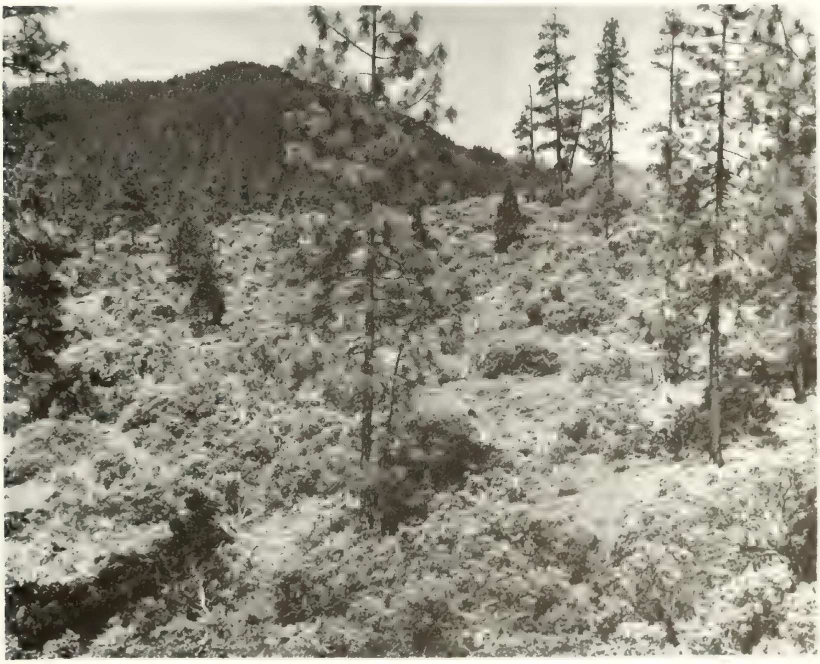


Figure 3.—This stand of Jeffrey pine near Weaverville in Trinity County is growing on soil derived from serpentine rock. Such areas are naturally low in productivity. The better timber stands on the hill in the background are growing on soils derived from schistose rock.

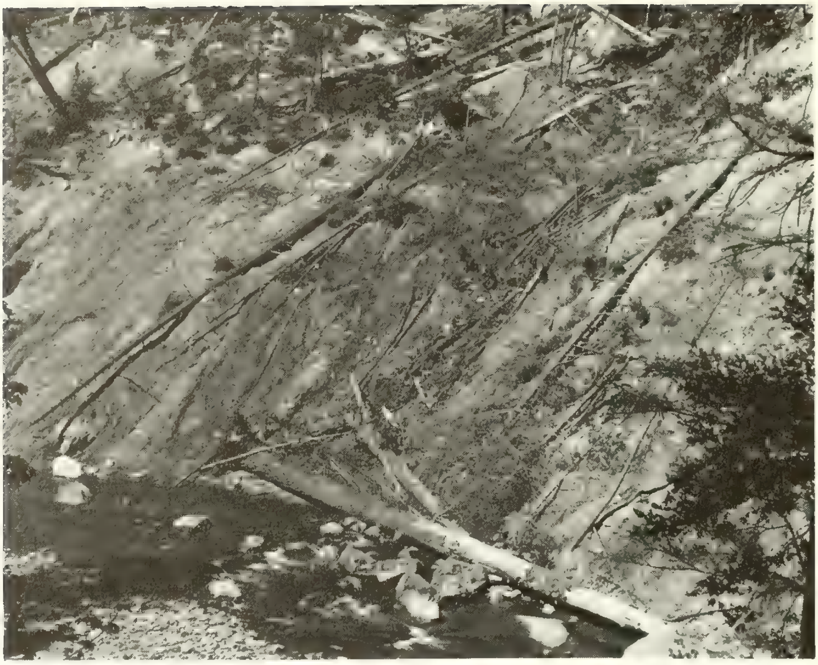


Figure 4.—A natural landslide along a stream in the Trinity National Forest, an example of an area that could be classified by the Forest Service as "special" [water influence zone] or "marginal" due to unstable soil.

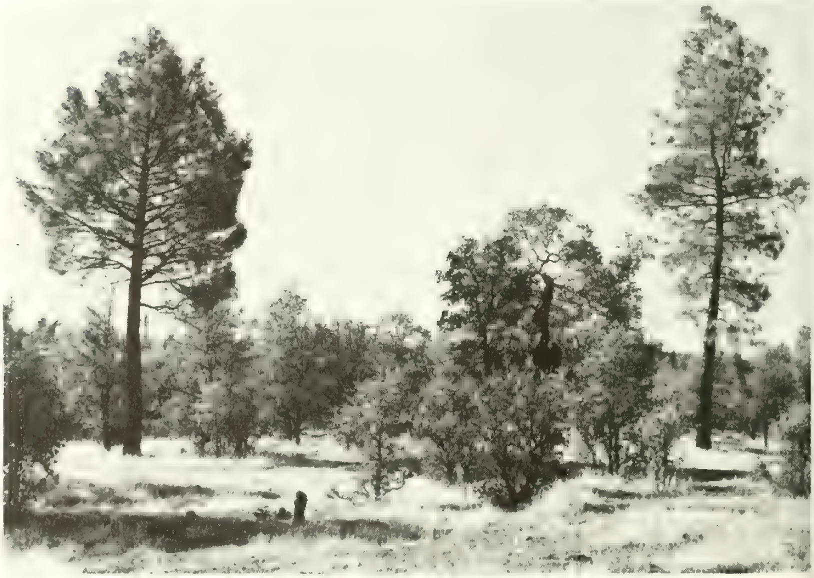


Figure 5.—Blue oak-grassland type with scattered Digger pine in the lower foothills of the southern Cascade Range in Shasta County. Blue oak and other noncommercial oak types occupy about 560,000 acres or roughly 6 percent of the forest land in the Northern Interior.

(fig. 6). (See page 70 for a list of the major woody plants and their occurrence in the Northern Interior, California.)

Forest fires (fig. 7), grazing, logging, mining (fig. 8), and other activities by man have altered the vegetation throughout the area. Many of today's stands of young pine and fir originated on sites deforested within the past 125 years. Extensive areas that were once forested now support only shrubs and grass, and there is evidence that conifers once grew in some areas now occupied only by hardwoods. In eastern Lassen County, juniper and in some cases Jeffrey pine have been slowly encroaching on rangeland in the forest-steppe transition zone. Changes due to man and nature

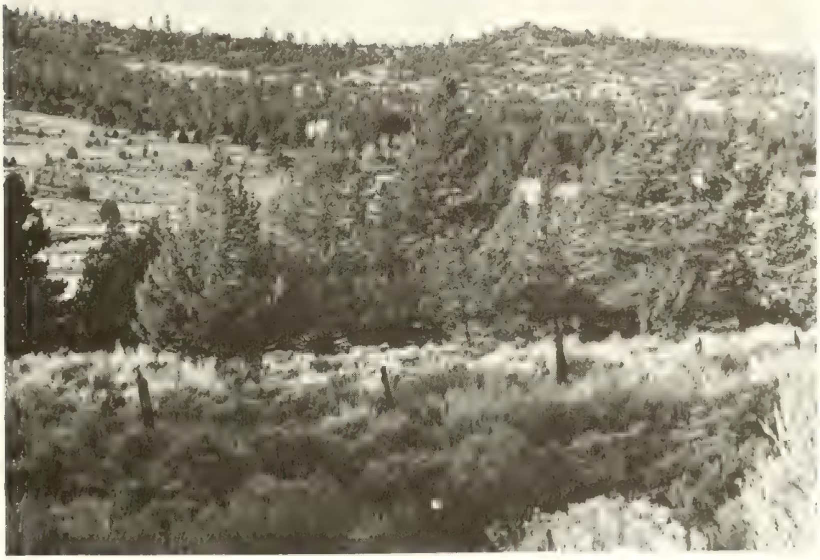


Figure 6.—Jeffrey-ponderosa pine stands grading into juniper-sagebrush at the lower forest fringe in Lassen County.

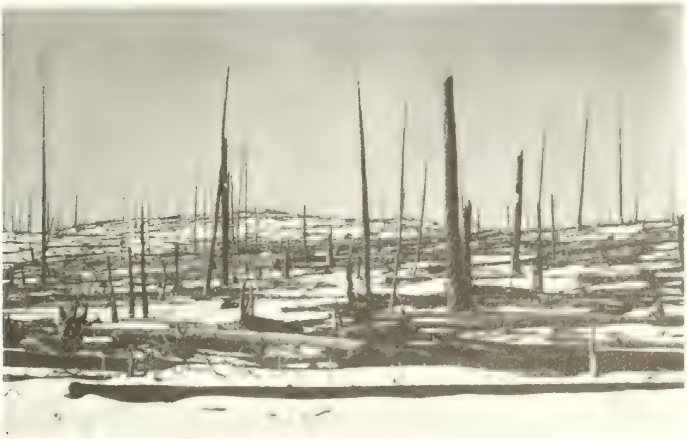


Figure 7.—Timber killed in the Antelope Mountain Burn, Lassen National Forest, one of many forest fires that have occurred in the Northern Interior.

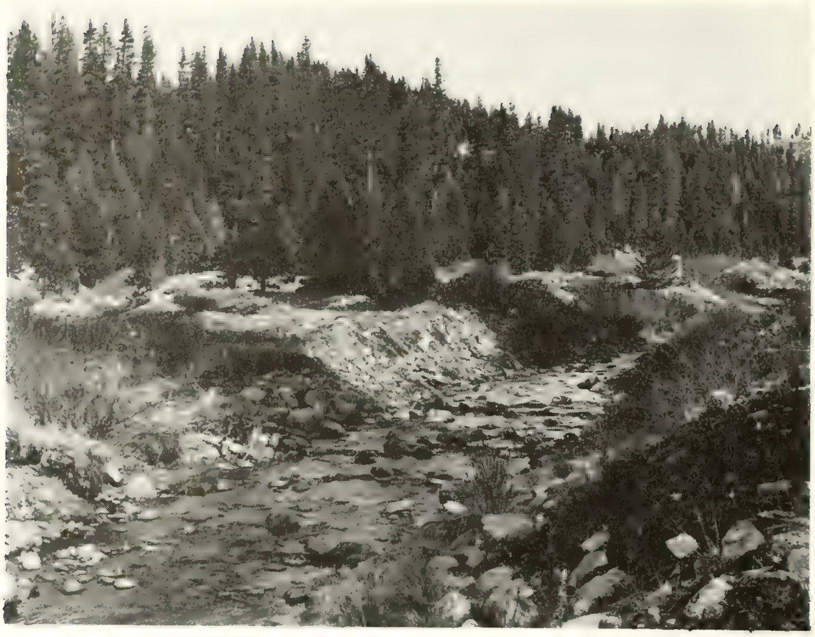


Figure 8.—Mine dredgings in Trinity County are still essentially nonforested after several decades.

are still taking place and will continue, perhaps at an increasing rate as demands for various resources increase.

The forests play a prominent role in the socioeconomic scene in the Northern Interior, providing employment in the forest products industries (fig. 9) and generating additional employment in construction, trade, services, public and private forestry positions, watershed management, and the outdoor recreation industry. Unlike the forest products industry which has generally stabilized, at least in terms of volume of wood cut, forest recreation continues to expand (fig. 10). Outdoor recreation use in 1970 in the five-county area was estimated to total 101 million participation days. By 1990 it is projected to total 177 million participation days, a 75-percent increase in 20 years.[1] Goods such as Christmas trees, pine cones, bark dust, mushrooms, and many others both tangible and intangible, originate in the forests of northern interior California. The water, wildlife, minerals fossils, archeological sites, and scenery are important to the 150,000 people living in the area, as well as to many from outside

---

[1] Source: State of California, Department of Parks and Recreation.

Figure 9.—Forest industries are important to the economy of northern interior California.

Figure 10.—The forests provide many forms of recreation.

THE FOREST INDUSTRY

Lumber dominates the forest industries

Plywood Production has increased

The trend has been toward fewer, larger mills

In 1972 there were 44 wood products mills in the five-county area—37 lumber mills, 5 veneer and plywood plants, and 2 pulp and board plants. In addition there was at least one post, pole, and piling plant. Lumber production dominates the forest industry, accounting for 89 percent of the total log consumption, compared with 98 percent in 1946. Veneer and plywood mills consume the other 11 percent, compared with 2 percent in 1946. The pulp and board industry relies entirely on mill residues in the form of chips, sawdust, shavings, and bark. The trend in the lumber industry in the Northern Interior, as throughout the Pacific Coast States, is toward fewer and larger mills, though recently a few small-log facilities have been built. Table 1 shows number of mills and percent of log consumption by industry for selected years.

Table 1--*Number of mills and percent of log consumption, by industry in California's Northern Interior for selected years, 1946-72*[1]

Industry[2]	1946	1956	1962	1968	1972
Lumber:					
Number of mills	132	107	53	45	37
Percent of log consumption	98	94	(3)	89	89
Veneer and plywood:					
Number of mills	3	7	6	5	5
Percent of log consumption	2	6	(3)	11	11
Pulp and board:					
Number of mills	1	1	1	3[4]	2
Total number of mills	136	115	60	53	44

[1] Sources: Forest Survey Release 6 (Burks and others 1948)
Forest Survey Release 20 (May 1953)
Forest Survey Release 20 (May and Baker 1957)
Forest Survey Release 34 (May 1958)
Forest Survey Release 35 (May and Baker 1958)
Resource Bulletin PSW-2 (Muerle and Hornibrook 1965)
California Timber Industries-1968 (Barrette and others 1970)
Resource Bulletin PNW-52 (Howard 1974)

[2] Includes only those sectors of the forest products industry for which time series data are available.

[3] Data not available for the Northern Interior because they were combined with other areas to avoid disclosure.

[4] Includes 2 processes at 1 location.

Forest industries provide for 17 percent of area's employment

Forest industries in the Northern Interior including logging, lumber and plywood manufacturing, millwork, prefabrication, wood preserving, and other wood products, and pulp and paper manufacturing[2] employed about 7,900 persons in 1973.[3] This was about 17 percent of the total reported employment in the five-county area and about 9 percent of the total employment in all forest industries[4] in California.

Logging accounted for about 18 percent of the forest industrial employment in the Northern Interior in 1973, sawing and planing mills 55 percent, veneer and plywood 12 percent, and pulp and paper and other wood products manufacturing 15 percent. Though 89 percent of log consumption in 1972 was by the lumber industry, (table 1) this sector accounted for only 67 percent of the nonlogging employment. The veneer and plywood sector, on the other hand, used 11 percent of the total logs consumed in 1972 but accounted for 14 percent of the nonlogging employment.

More timber is cut than is processed in Northern Interior counties

Northern Interior forests also contribute directly to forest industrial employment in other areas. In 1972, about 100 million more board feet (or about 8 percent more logs) were cut in the Northern Interior woods than were processed in mills in the area. Logs were shipped mainly to the north coast, the Sacramento Valley, and to Oregon. Trinity County is the largest net exporter; it processed less than half of the logs cut in the county in 1972 and transported 36 percent outside the Northern Interior. Lassen and Modoc Counties are also net exporters, but Siskiyou and Shasta counties process more logs than are cut in these counties.

---

[2] Standard Industrial Codes 2411-2499, and 2621 (U.S. Office of Management and Budget 1972).

[3] Source: State of California, Department of Human Resources Development.

[4] Standard Industrial Codes 2411-2499, and 2611-2661 (U.S. Office of Management and Budget 1972).

FOREST AREA

Ownership

69 percent of the area is forest, including . . .

- **43 percent commercial forest**
- **23 percent unproductive forest**
- **3 percent productive reserved in parks and wilderness**

In the five counties of Lassen, Modoc, Siskiyou, Shasta, and Trinity, 9,678,000 acres or 69 percent of the total land area is classified as forest land. Commercial forest land[5] totals 6,028,000 acres or 43 percent of the total land area. Included are the upland areas, where virtually all the commercial conifer trees grow, and some hardwood sites along streams. Unproductive forest land totals 3,211,000 acres or 23 percent of the total land area. Included as unproductive forest are the oak stands(fig. 5) in the foothills below the conifer zone, juniper, chaparral, forested areas that are too steep and rocky to harvest or manage for continuous production of wood, forest lands incapable of growing 20 cubic feet of wood per acre because of limiting moisture (fig. 11) or soil toxicity, and upper timberline forests (figs. 12 and 13). Productive forest land reserved by law in National Forest Wilderness and National, State, and County Parks totals 439,000 acres or 3 percent of the land area.

---

[5] See "Definition of Terms," page 73.

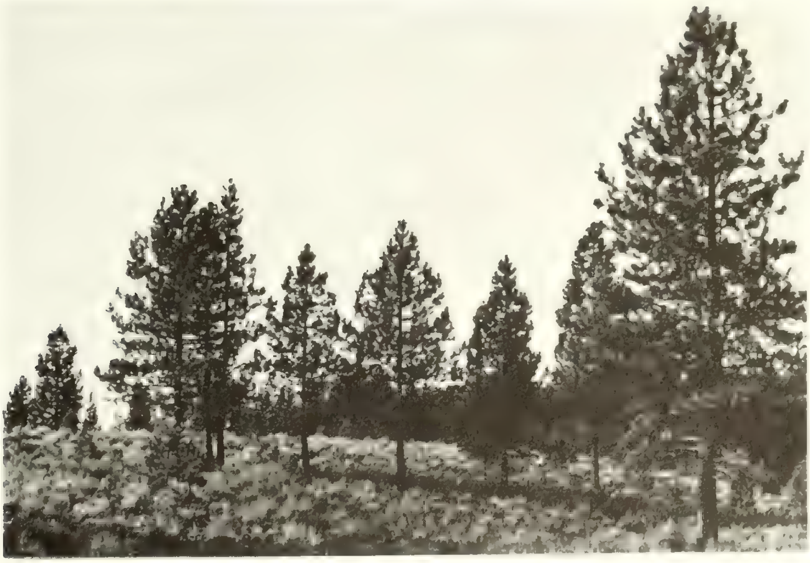


Figure 11.—This forest fringe area in Modoc County near Adin is incapable of growing 20 cubic feet of wood per acre per year. Individual trees are growing reasonably well, but the area will support very few trees, per acre, due to limiting moisture.

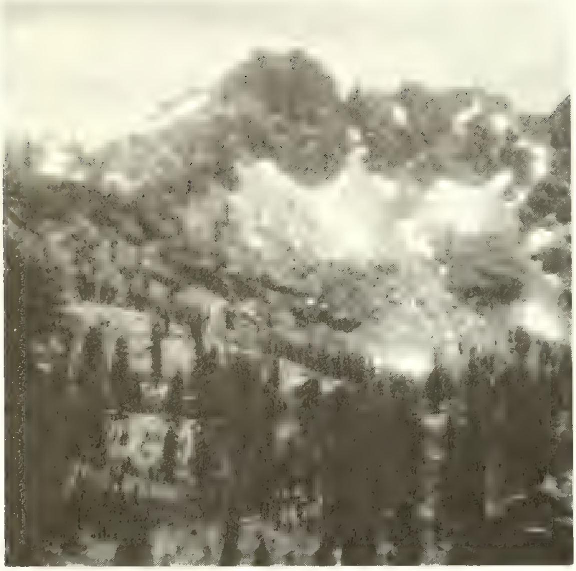


Figure 12.—Upper timberline in the Salmon-Trinity Alps. The sparse stand shown in this picture includes Shasta red fir, mountain hemlock, and the relatively rare foxtail pine.

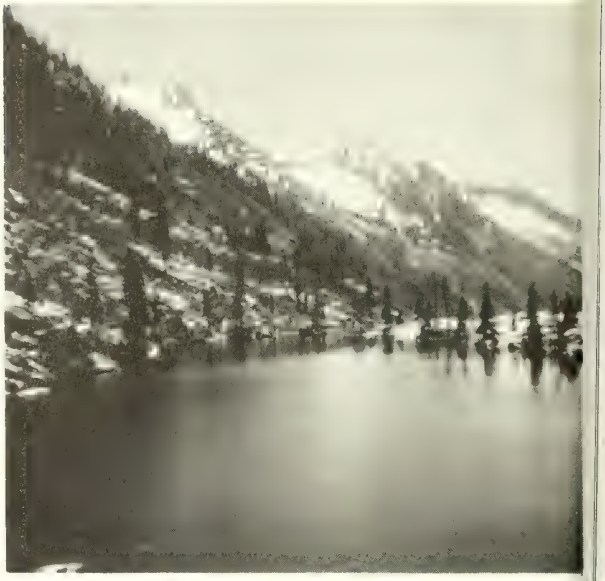


Figure 13.—Upper Canyon Creek Lake in the Salmon-Trinity Alps, bordered by low-site forests classified as unproductive.

National Forests contain 58 percent of the commercial forest but—

National Forests contain 3,474,000 acres or about 58 percent of the commercial forest land. Included are all or portions of the Lassen, Modoc, Shasta, Trinity, Klamath, Six Rivers, Mendocino, and Plumas National Forests of Region 5 and small portions of Region 6's Rogue River National Forest and Region 4's Toiyabe National Forest.

Not all acres will produce full yields of timber . . .

- **5 percent requires modified timber management practices**

Not all of the 3,474,000 acres of commercial forest land in National Forests is or will be managed primarily to produce timber. In many areas the protection of other resource values requires that timber harvesting be modified. These areas, classified by the Forest Service as "special component," may yield considerably less timber than areas that are managed primarily for timber production. About 5.3 percent of the total commercial forest land in the National Forests in the Northern Interior is in this category. Included are the Whiskeytown-Shasta-Trinity National Recreation Area, travel and water influence zones, and forest land bordering some developed sites.

- **17 percent has low yield expectations in the near future**

Another category of land from which less than full timber production can be expected is the "marginal component." This amounts to about 16.8 percent of National Forest commercia forest land in the Northern Interior. Included are extensive areas of low value hardwoods and other species (mostly knobcone pine presently low in demand; soils that are unstable (fig. 4), shallow (fig. 14), and rocky; areas not now economically loggable because of access or terrain; and nonstocked areas that will not be reforested because of lack of funds.

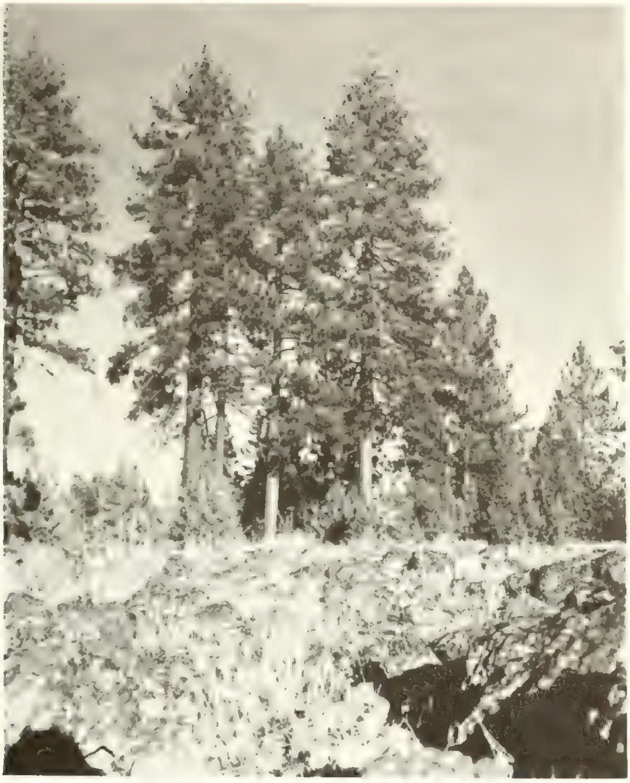


Figure 14.—Extensive areas of scab rock and small "pockets" of soil stocked with Jeffrey and ponderosa pines and western juniper occur in the lava-flow country in and near the Modoc National Forest. Such areas may support marketable trees but are difficult to manage and have low future yield expectations.

- **3½ percent may become wilderness**

About 124,000 acres or 3.5 percent are in areas being studied for possible inclusion in wildernesses.

- **1 percent is not planned for timber management**

Commercial forest land in experimental forests, recreation and administrative sites, and isolated tracts where sustained periodic harvest is impractical is in a category called "unregulated." Sustained yield timber production is not planned for these areas, which amount to about 1.3 percent of the total commercial forest land in National Forests.

Other public agencies hold about 2 percent of the commercial forest

The Bureau of Land Management, Bureau of Indian Affairs,[6] other Federal and State agencies, and counties and municipalities administer 154,000 acres or about 2 percent of the total commercial forest land.

---

[6] Indian lands are privately owned, but have been included here as public.

40 percent is privately owned including . . .

- **11 percent by timber companies**
- **19 percent by non-mill-operating corporations—**

Privately owned commercial forest land is estimated at 2,400,000 acres or about 40 percent of the total in the Northern Interior.

At the time the fieldwork was done for this inventory, 679,000 acres or 11 percent of the total commercial forest land was owned by timber industry companies operating wood processing mills. Miscellaneous private corporations other than mill-operating timber companies owned 1,125,000 acres or 19 percent of the total. Since the inventory was completed, a number of land transactions have taken place. Over 150,000 acres of commercial forest land have been transferred from miscellaneous private corporate owners to forest industry. The tables in this report do not reflect these transactions.

90 percent of which is owned by 4 corporations who manage for timber production and 10 percent by banks and land developers

Of the 1,125,000 acres of miscellaneous private corporate commercial forest land, about 90 percent was owned by four corporations. Even though these firms do not operate wood processing mills, timber production has been and will probably continue to be one of their land management objectives. Most of the remaining 10 percent of the commercial forest land in miscellaneous private corporate ownership is held by land developers and subdividers, banks, and other financial institutions.

- **10 percent of total commercial forest is owned by farmers and other noncorporate owners**

Ranchers, farmers, and noncorporate miscellaneous private owners held 596,000 acres or 10 percent of the total commercial forest land.

Not all commercial forest in other public and private ownerships will produce full yields

As with National Forests, not all commercial forest land in other public or private ownership is currently manageable for full timber yields because of physical factors or conflict with other uses. An attempt was made to classify other public and private commercial forest land into timber management intensity and suitability categories similar to those used by the National Forests. To do this, each field plot was examined and placed into one of several categories based strictly on physical evidence.

2 percent of other public forests are in nontimber uses; half of these are marginal for timber production

About 2 percent of other public commercial forest land is currently in areas where recreational development or other uses will reduce or possibly eliminate timber production. About 50 percent of the other public commercial forest is in areas with limiting physical or economic factors, including 29 percent in low-value species such as hardwoods and knobcone pine and arid fringe areas of juniper-pine or Digger pine, 3 percent in high elevations where forest regeneration has generally failed, and 18 percent in steep, rocky, and unstable areas and periodotite-serpentine soils.

2 percent of private forests are in nontimber use and 14 percent are marginal

About 2 percent of private commercial forest lands is in area currently being developed for nontimber use (primarily residentia sites), though trees are still present. Subdivisions for real estat development shown on the county assessor's records were no included unless on-site construction had been started. About 14 percent of private commercial forest land is in areas with limiting physical or economic factors, including 10 percent in low-value species such as hardwoods and knobcone pine, and arid fringe areas of juniper-pine or Digger pine, 1 percent in high elevation problem areas, and 3 percent in steep, rocky, and unstable areas and peridotite-serpentine soils.

Even a larger area may produce little timber due to . . .

The previously described limitations or withdrawals total 18 percent of the commercial forest land outside National Forests. Although difficult to define, an even greater area has low probability of contributing to the future timber supply. Many sites have been difficult to restock in desirable conifers following logging. All of the hardwood areas except for a few bottomland stands show evidence of past conifer stocking, yet most of these areas are restocking in conifers very slowly, if at all. Forest fires and logging have caused these conifer sites to become stocked with hardwoods. More hardwood areas can be expected in the future, since fires and logging will continue. The Z'berg-Negedly Forest Practices Act of 1973 (California, State of, 1974) requires that considerable effort be made to restock conifers in logged areas, but some recalcitrant sites will not be satisfactorily reforested in spite of managers' efforts. Other areas that currently show no evidence of problems may indeed be difficult to manage due to soils, moisture, or other physical factors not currently apparent to the land managers. Finally, many landowners have objectives other than timber growing (fig. 15).

- **Difficult sites**
- **Objectives of owners**

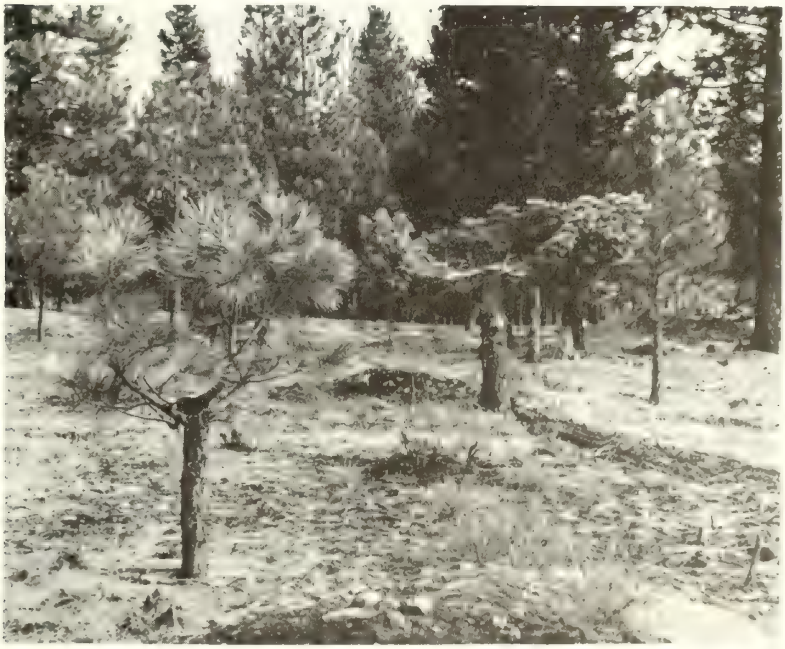


Figure 15.—Many stands on private lands are growing less wood than possible because of the landowners' objectives. This privately owned stand in Lassen County is producing both wood and Christmas trees, but not without some trade offs.

Forest conversions will continue

Most commercial forest land is grazed, in some areas so heavily that seedling damage, soil compaction, and erosion have resulted. Several large residential developments are registered by the county assessors and will continue to take land out of timber production. Roadbuilding will continue, especially in the more inaccessible areas in the western part of the Northern Interior. Other forest conversions which have taken a considerable area out of timber use in the past—powerlines, reservoirs, canals, mining developments, etc.—will also continue.

Forest Types

Much of area is in mixed conifers

Much of the main forest zone of the Northern Interior is mixed-conifer type, consisting of various combinations of Douglas-fir, white fir, ponderosa and sugar pines (fig. 16), and incense-cedar. Fairly pure stands of Douglas-fir are found in the extreme western portion of the area (fig. 17) and also in small scattered stands elsewhere. Pure stands of white fir and/or red fir occur in the higher elevations above the mixed-conifer zone; in some areas they also contain western white pine, lodgepole pine, Jeffrey pine, mountain hemlock, foxtail pine (fig. 12), and Brewer spruce (fig. 18). Pure stands of ponderosa pine (fig. 19) occur mainly on the drier sites below the main forest zone in the western portion of the area and on the drier eastern slopes of the Cascade Range.

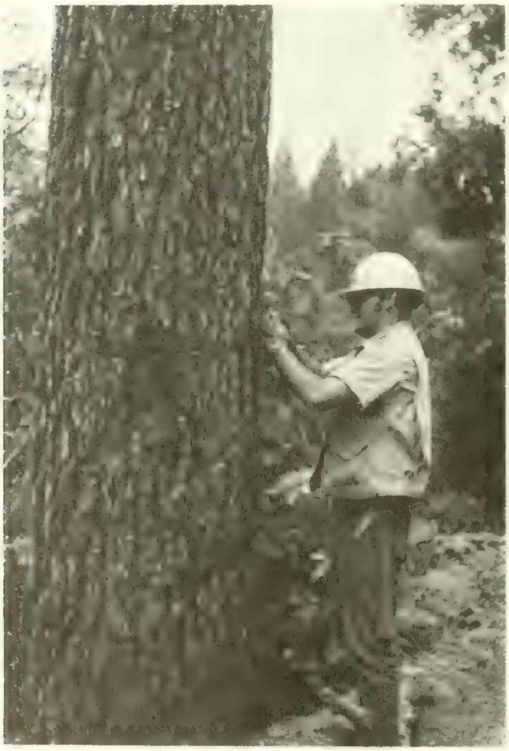
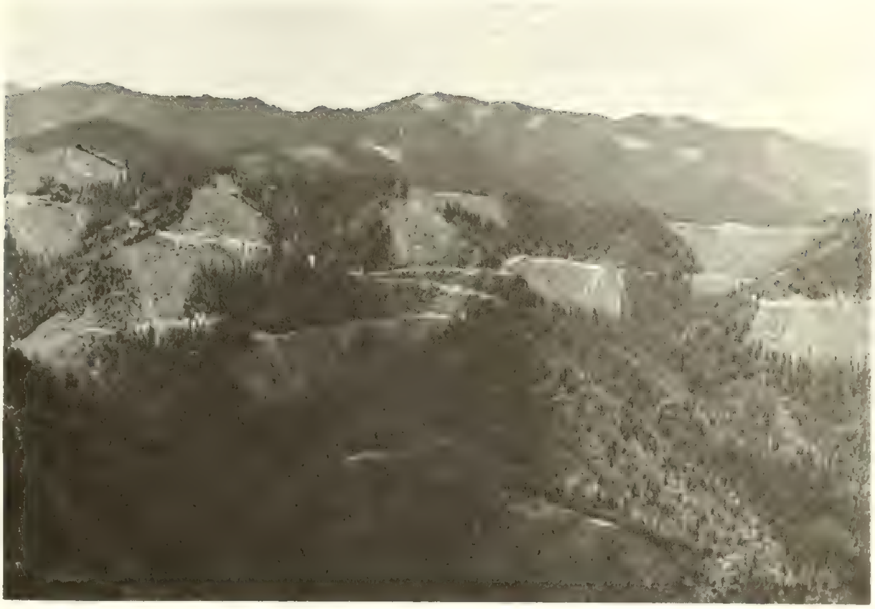


Figure 16.—Timber inventory crewman measuring a sugar pine on private land in Trinity County.



ure 17.—Clearcut patches in Douglas-fir type in the extreme western portions of the Northern Interior on the Big Bar District of the Trinity National Forest.

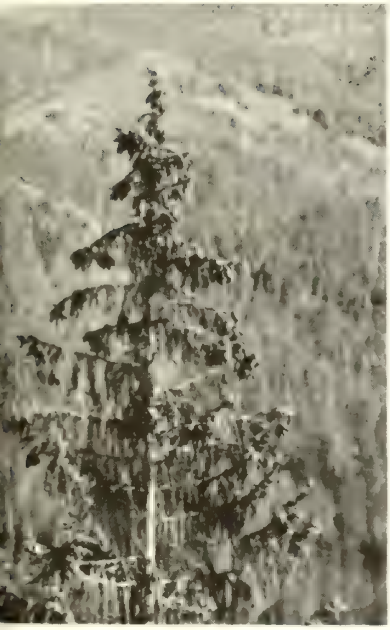


Figure 18.—Brewer spruce, a rare tree found only in the Siskiyou Mountains, grows near upper timberline.

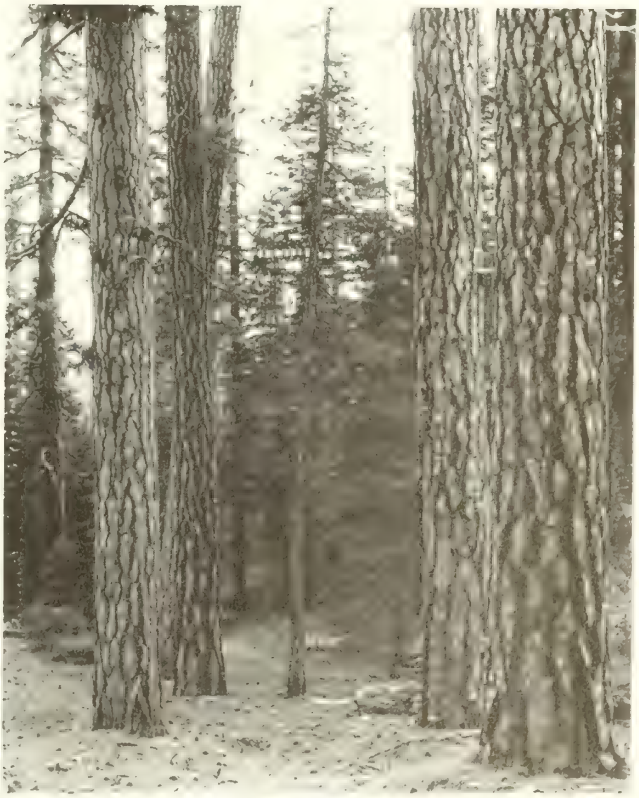


Figure 19.—This stand of large sawtimber in Lassen County is fairly typical of many areas of the mixed-conifer type. Ponderosa pine often forms small, even-aged "clusters" which are surrounded by other species. White fir is often present in the understory where less tolerant ponderosa pine usually cannot survive. Cutting the large pines has often resulted in an increase in white fir.

Douglas-fir is the most extensive type

Forest types (fig. 20) shown in this report are based on the plurality of tree stocking. A mixed-conifer stand, for example, that contains 40 percent Douglas-fir, 35 percent ponderosa pine, and 25 percent white fir would be classified as Douglas-fir type because this species has the plurality of stocking.

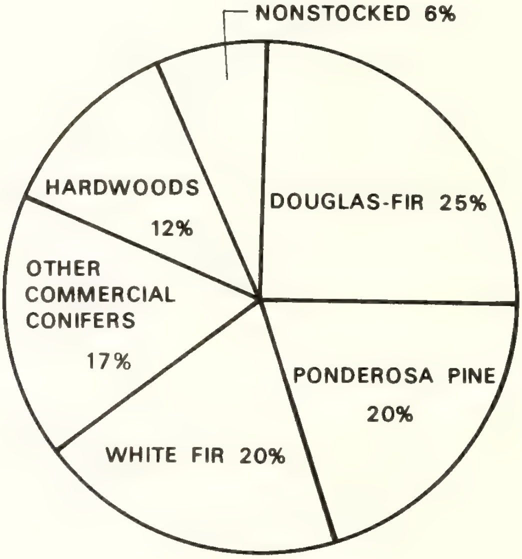


Figure 20.—Sixty-five percent of the commercial forest in northern interior California is Douglas-fir, ponderosa pine, and white fir types.

Stand Size and Age

75 percent of area is in sawtimber stands

Sawtimber stands occupy 4,503,000 acres or 75 percent of th total commercial forest area (fig. 21). About 62 percent of th sawtimber stands are on National Forest lands.

Poletimber stands occupy 399,000 acres, only 7 percent of th commercial forest area, and seedling and sapling stands (fig. 22 722,000 acres or 12 percent.

Many sawtimber stands have been partially cut . . .

These stand-size figures alone give only a general view of th forest, since many sawtimber stands consist mainly of remnan trees in areas that have been selectively logged. These residua stands are difficult to characterize—some are well stocked wit vigorous trees; some are overstocked and could be thinned; som

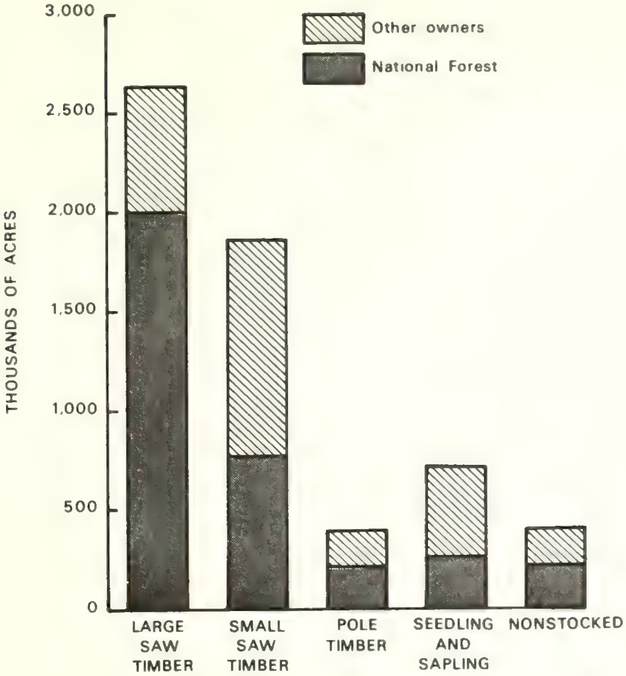


Figure 21.—Most of the commercial forest land in northern interior California is stocked with sawtimber stands. National Forests hold most of the large sawtimber.

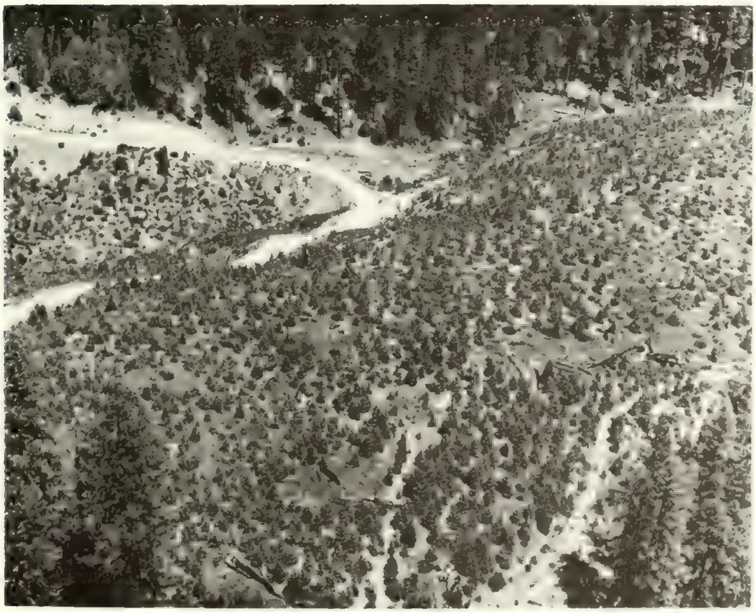


Figure 22.—Ponderosa pine plantation in a clearcut patch in Douglas-fir type in the Trinity National Forest. This area is well stocked except in the old spur roads, landings, and places where slash piles were burned. Seedling-sapling stands occupy 722,000 acres or 12 percent of the total commercial forest land in the Northern Interior.

And are difficult to characterize

are stocked with culls and damaged trees. Some are in rather poor condition because of patches of inhibiting brush, erosion and soil compaction due to logging, grazing, and other activities; and insects and disease.

One-third of the area is in old stands

About 33 percent of the commercial forest area is in stands over rotation age.[7] National Forests contain 75 percent of these older stands, which amount to 43 percent of total National Forest commercial forest area.

Much of the uncut older stands, in both public and private ownerships, is in steep mountains in the western part of the area with land stability problems and costly accessibility. Nearly all of the flat and gently-sloping lands have been logged.

Young stands occupy most of the flat and gentle-sloping land

Stands under rotation age occupy 60 percent of the commercial forest area. Much of this is in flat and gently rolling country in the eastern part of the area.

Forest Land Productivity

The forest area has been classified into productivity categories called cubic-foot site classes (table 7.) These categories are useful for ranking the **relative** capacity of the land to produce wood. They do not necessarily indicate the realizable potential of the forest. They are based on normal yield tables developed from natural, fully stocked, even-age stands of single species. Such yields could be realized across all acres only if all stands were even-aged and kept fully stocked with single species (fig. 23), if the forest were perfectly regulated with even-age class distribution, if all stands were clearcut exactly at the age of growth culmination, and if all were immediately restocked. These conditions will obviously not be met over large areas.

Forest industry lands have the highest per-acre potential

In Northern Interior California, forest industry lands are of highest average productivity, followed by National Forests, farmer and miscellaneous private, and other public, in that order. Tota area capable of growing 85 or more cubic feet per acre per year amounts to:

47 percent of forest industry lands
34 percent of National Forest lands
30 percent of farmer and miscellaneous private lands
25 percent of other public lands

---

[7] Rotation age as used here: Lodgepole pine—100 years; other conifers, Shast Trinity, and Western Siskiyou Counties—100 years; other conifers, Lassen Modoc, and eastern Siskiyou Counties—140 years; hardwoods—50 years.

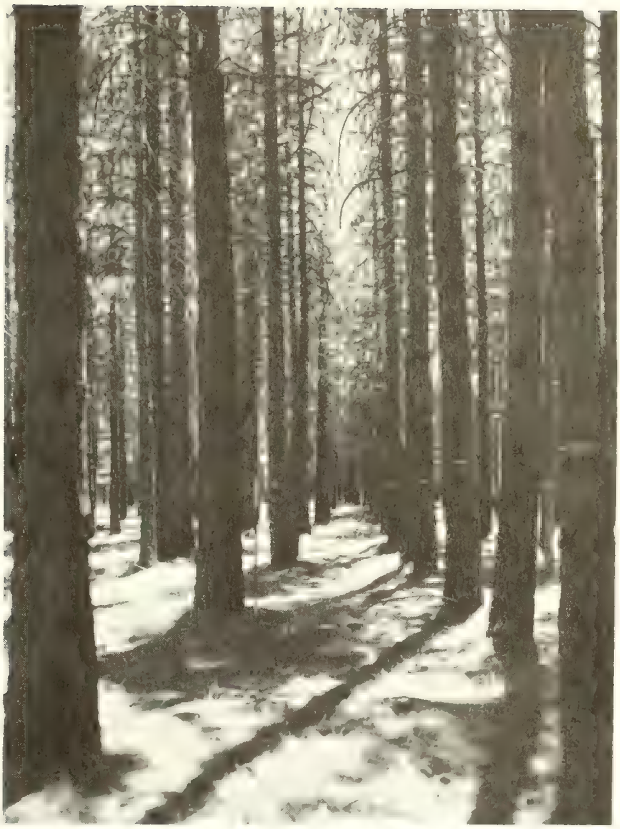


Figure 23.—This timber stand near McCloud is said to be the oldest successful ponderosa pine plantation in California. The stand is 53 years old and contains 7,200 cubic feet and 30,000 board feet per acre [Scribner rule], an example of the potential of some of the Northern Interior's forest land under intensive management.

Stocking Condition

72 percent of the area is adequately stocked, but . . .

Hardwoods occupy a large area of conifer land

About 72 percent of the commercial forest land is medium to well stocked, 22 percent is poorly stocked, and only 6 percent is nonstocked. Hardwood (largely California black oak, tanoak, and madrone) trees are included in these stocking figures. Since most hardwoods are relatively unimportant to the forest industry in this area, they are often considered a liability rather than an asset. Most of the 687,000 acres of hardwood types occur on land that has grown conifers in the past and could presumably grow conifers in the future. This in effect raises the area of nonstocked land to about 18 percent of the total commercial forest area. Much of the nonstocked and poorly stocked land, including some hardwood types, is in arid forest fringe areas where forest regeneration is difficult.

In spite of the large area of hardwoods, the stocking condition, in terms of occupancy of trees, is relatively good, even in areas that have been extensively logged. This is due to the large variety of species that grow in the area, to the practice of selective logging, and to successful regeneration in recent years of logged and burned areas (fig. 22).

Stocking by ownership is . . .

Ownership	Stocked: Well (60+ %)	Medium (36-59%)	Poorly (11-35%)	Nonstocke (0-10%)
	Percent			
National Forest	39	34	21	6
Other public	24	37	23	16
Forest industry	38	30	26	6
Farmer and miscellaneous private	34	39	20	7
All owners	37	35	22	6

Though the forest is fairly well stocked, many areas are no stocked with the best trees for timber growth. A detaile discussion appears in the section on growth and mortality.

---

[9] The nonstocked area excludes over 300,000 acres in old burns wh reforestation efforts have failed. These areas are no longer considered commer forest land. Had they been included, the nonstocked area would have amounte t about 11 percent of the total.

Changes in Forest Land Area

Commercial forest has decreased 419,000 acres in 17 years . . .

Between 1953 and 1970, there was a net decrease in commercial forest area of about 419,000 acres or 6.5 percent. Ownership shifting during this period makes it difficult to trace exact losses within an ownership class, but these general changes can be noted:

1. Physical losses of commercial forest land totaled about 80,000 acres. About 60 percent of this was on National Forest lands, and 40 percent was on private lands.

- **Including physical losses caused by roadbuilding (43,000 acres)**

The leading cause of forest loss was roadbuilding (fig. 24), accounting for about 43,000 acres or 54 percent. National Forests in the five-county area built about 5,000 miles of permanent logging roads between 1953 and 1970, and private owners about 2,500 miles. Not included are the numerous temporary roads, spurs, and skid trails necessary in logging. Highway construction and roads built to new housing developments also contributed to the loss of commercial forest land.

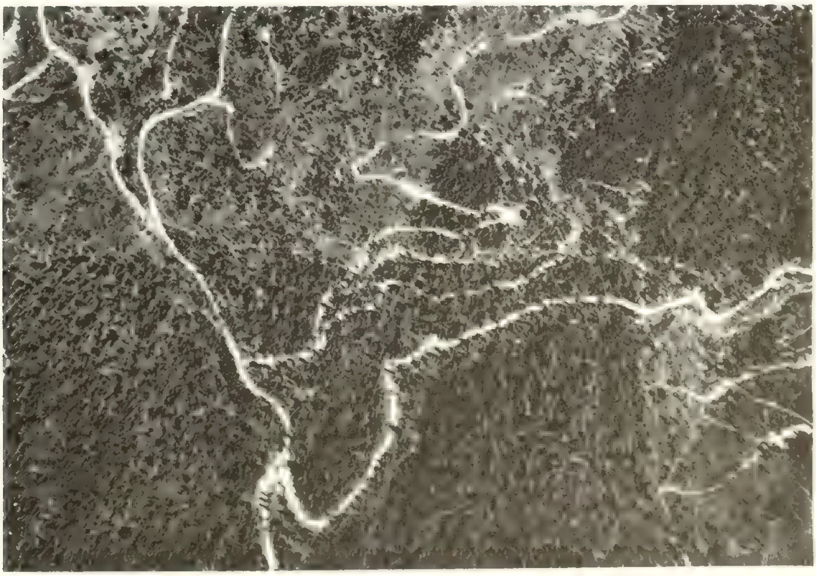


Figure 24.—Logging roads on the Shasta National Forest and adjacent private lands. Since 1953 about 7,500 miles of permanent logging roads have been built in the Northern Interior. Though today's technology and economics make roads necessary to manage forests, roads also reduce the total timber-growing potential of the land and affect other resources such as wildlife, scenery, and water.

- **Reservior construction (25,000 acres)**

Reservoir construction accounted for about 25,000 acres or 31 percent of the commercial forest loss. Over 50 reservoirs were built between 1953 and 1970, including many less than 100 acres in size and a few over 100 acres. Several were in nonforest areas. Trinity (Clair Engle) Lake (fig. 25) was the largest, covering 16,400 acres, mostly forested. Shasta Lake—29,500 acres—was completed in 1949 so is not included here as a forest loss.

- **And other clearings (12,000 acres)**

Forest clearing (fig. 26) for grazing, powerline construction, residential and recreational development, and miscellaneous clearings (mining, radar stations, airstrips, etc.) accounted for the remaining 12,000 acres or 15 percent.

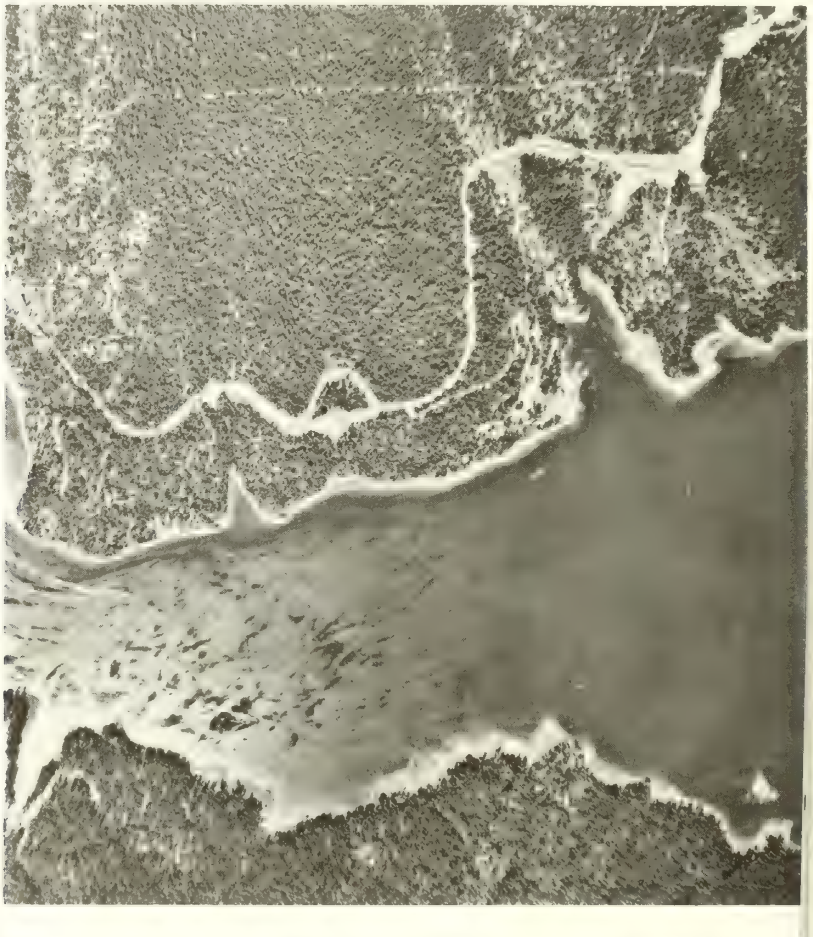


Figure 25.—Portion of Trinity Lake, the largest of many reservoirs built in the Northern Interior since 1953. The reservoir has brought about further forest losses due to rerouting of flooded road and lakeside developments.

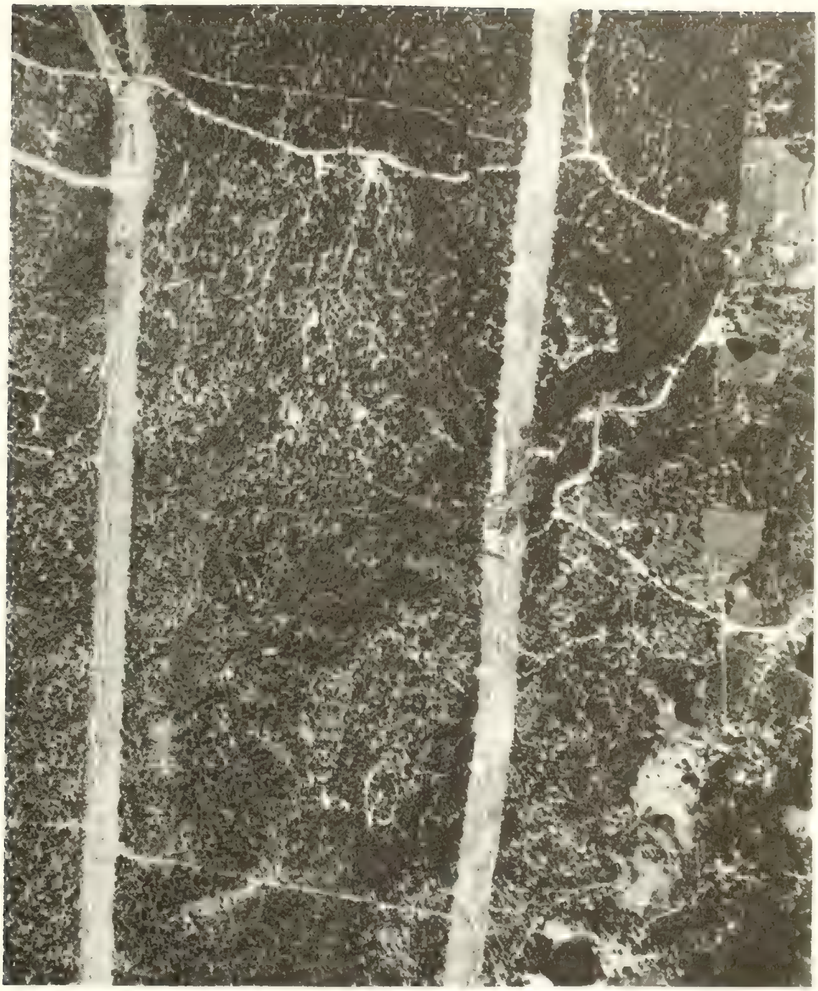


Figure 26.—Aerial view in Shasta County showing forest losses due to construction of powerlines, roads, reservoirs, and clearings for agriculture and homesites. The powerline rights-of-way are 300 feet wide, occupying about 36 acres for each mile in length.

- **Reclassification decreased commercial forest by 355,000 acres**

New techniques to assess stockability were used

2. Reclassification as noncommercial or nonforest of land formerly called commercial forest accounts for a reduction of about 355,000 acres since 1953. Of this, about 35,000 acres were in private ownerships. These lands were reclassified as noncommercial by an improved method of estimating productivity (MacLean and Bolsinger 1973a, 1973b) in areas where tree stocking is limited due to environmental factors.

About 320,000 acres of National Forest land formerly called commercial were reclassified as noncommercial or nonforest based on a closer inspection of the land and on experience gained since previous inventories. The Shasta National Forest carried the greatest reduction (about 225,000), but reductions also occurred

Some burned areas are considered nonstockable—hence not commercial

In the forest fringe, deforestation seems permanent

Is a change in climate occurring?

on the Lassen, Plumas, Mendocino, and Modoc National Forests. Included are extensive nonstocked burned areas where considerable investment in reforestation measures has failed. These areas are largely transition between the chaparral and pine and mixed-conifer vegetation types (fig. 27), or between sagebrush scrub and pine forest. Fires and other disturbance have pushed back the conifer forests along much of the forest transition zone in California (figs. 28, 29). The general lack of natural reforestation and failure of artificial reforestation attempts in this zone suggest a possible natural trend of forests retreating to higher (cooler, more moist) elevations with nonforest vegetation types replacing them at lower elevations. Numerous clues of migrating vegetation in California's past have been noted (Detling 1961, Munz and Keck 1970, Whittaker 1960). In the case of some of the nonstocked burns in the Northern Interior, no definite conclusion can be reached, since the period of observation represents an extremely short period of time. National Forest managers have based their decisions on substantial evidence that these deforested areas will not support timber-producing trees in the foreseeable future.

16,000 acres were reclassified as commercial from reserved categories

3. Since 1953, about 16,000 acres were reclassified from productive reserved to commercial forest. Included were parcels of the Marble Mountain, Salmon-Trinity Alps, and Yolla Bolly areas in Shasta, Siskiyou, and Trinity Counties. The Forest Service

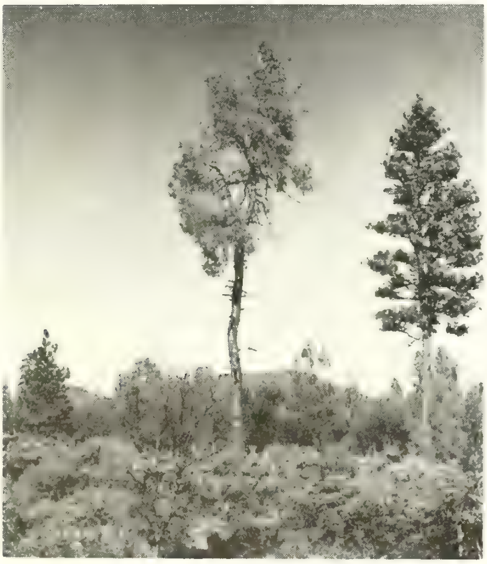


Figure 27.—This transition area between the chaparral-hardwood-Digger pine type and ponderosa pine type is considered noncommercial forest. Though the individual pine trees indicate a fairly high site, the overall area is not manageable for timber production.

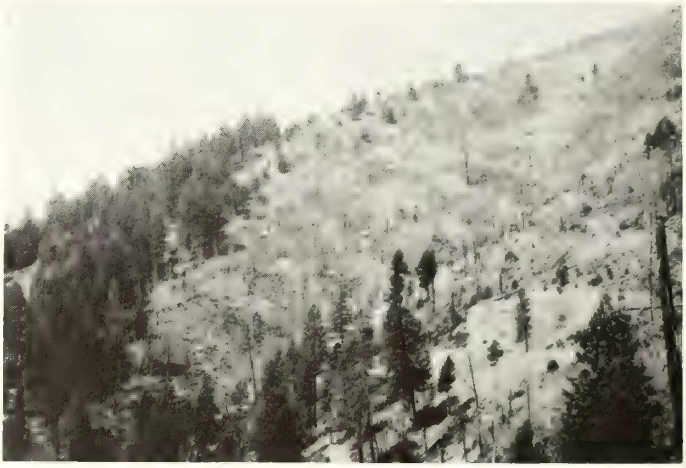


Figure 28.—This south-facing slope near the lower forest fringe zone in Siskiyou County was burned in the early 1960's and promptly planted in ponderosa pine. Nearly all the planted trees died, and very few natural trees have become established. Many nonforested slopes in this area show evidence of past occupancy by forests; but there is little evidence that they will support commercial stands in the foreseeable future.

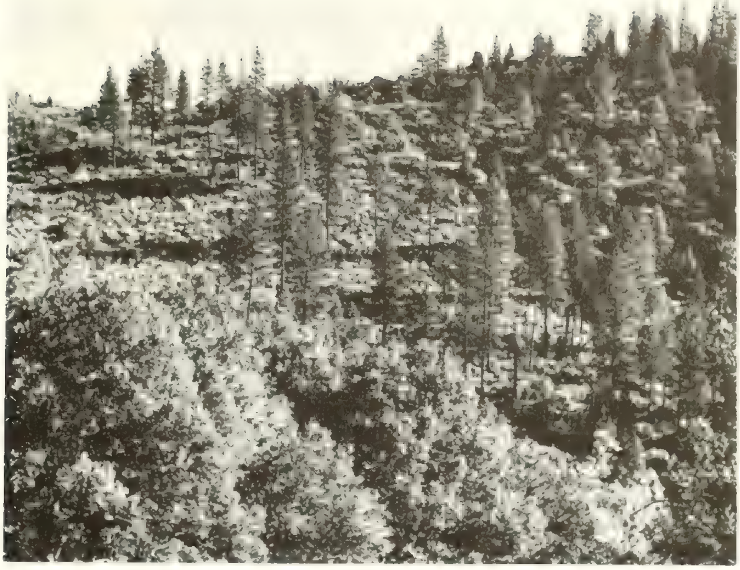


Figure 29.—This area in Shasta County in the lower commercial forest zone once supported considerably more commercial conifer trees than are now present. Oak trees and manzanita brush now occupy much of the area. Though conifer seed source has been present for many decades, conifer stocking is not increasing.

has recently reviewed large areas for possible Wilderness classification, and in the process excluded some areas that had been carried as "reserved" by administrative decision but had not been set aside by law.

Ownership Changes

National Forests are gaining land

Other public lands are decreasing

National Forests have acquired about 40,000 acres of commercial forest land since 1953, mostly from private ownerships but also a small amount from other public agencies. Other public ownerships decreased by about 110,000 acres or 42 percent. Included were lands held by the Bureau of Land Management, Bureau of Indian Affairs, miscellaneous Federal agencies, and the State of California. Most of the other public land went into private ownership.

Private lands are changing owners—forest industry ownership is increasing; other private decreasing

Ownership of commercial forest land within the private sector has been changing rather continuously, but the greatest change occurred after this inventory was completed when about 150,000 acres transferred from miscellaneous private corporate to forest industry. The overall trend has been toward more forest industry-owned land and less miscellaneous private.

TIMBER VOLUME

Northern Interior forests contain 30 percent of California's timber . . .

Mostly in large softwood trees

National Forests hold most of the large timber . . .

In steep country in Siskiyou and Trinity Counties

Most of the volume is Doublas-fir, pines, and true firs

Commercial forest land in the Northern Interior contains 15.9 billion cubic feet and 86.0 billion board feet (International 1/4-inch rule) of standing timber, about 30 percent of California's total. About 99 percent is softwood species. About 64 percent of cubic-foot volume and 76 percent of board-foot volume are in trees 21.0-inch d.b.h. and larger.

National Forests have about 70 percent of the total volume, and 74 percent of the volume in trees 21.0-inch d.b.h. and larger (fig. 30). Siskiyou and Trinity Counties have the greatest concentrations of volume, much of it in mountainous areas that are presently unroaded and difficult to manage due to unstable soils and steep, rocky slopes.

Over 40 species of trees grow in the five-county area, but the bulk of the volume is in a few valuable conifer species. Douglas-fir, though rare in Lassen and Modoc Counties, is the most prevalent species in the Northern Interior, comprising 36 percent of the total cubic-foot volume. Ponderosa and Jeffrey pines account for 22 percent, white (fig. 31) and red firs for 24 percent, and sugar and western white pines comprise 8 percent. Of the remaining 10 percent of cubic-foot volume, over half is other conifers, including incense-cedar, lodgepole and knobcone pines; and the balance is hardwoods, largely California black oak, tanoak, and madrone.

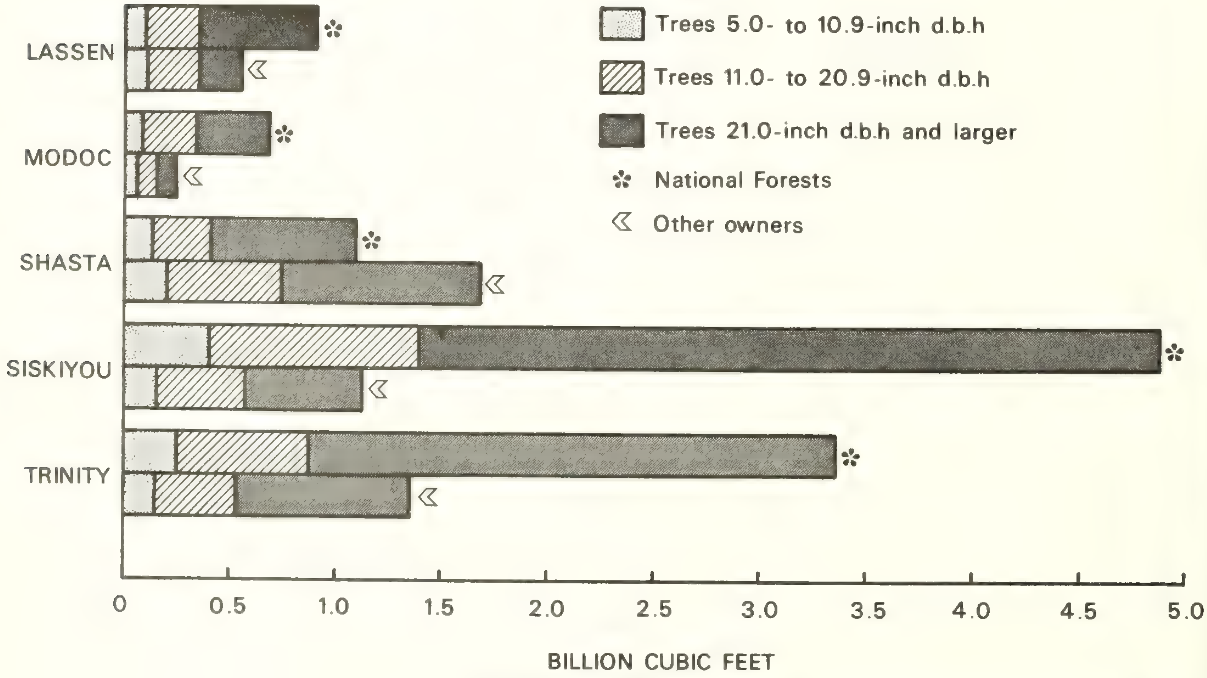


Figure 30.—Most of the volume is in large trees on National Forests; Siskiyou and Trinity Counties have two-thirds of the total.

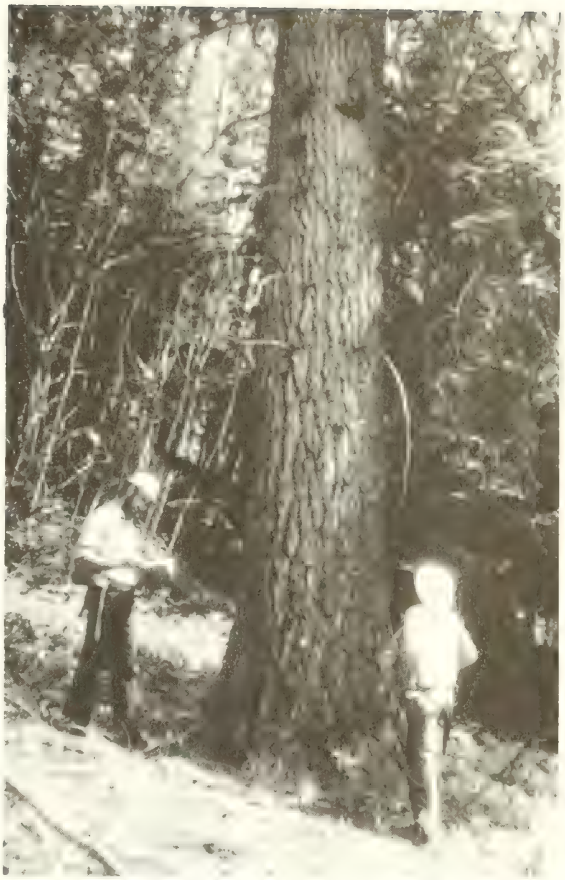


Figure 31.—Timber inventory crew appraising an old-growth white fir that is infected with Indian paint fungus [*Echinodontium tinctorium* E. & E.], a heart-rotting disease frequently found in both white and red firs in the Northern Interior.

National Forests hold 78 percent of the Douglas-fir volume, 60 percent of the ponderosa pine, and 65 percent of all other softwoods.

Total volume has declined 21 percent in 17 years

Since 1953, International 1/4-inch board-foot volume in trees 11.0 inches and larger has declined about 21 percent. Volume in public ownership has declined about 17 percent; volume in private ownership has declined about 45 percent.[9]

Hardwoods are increasing

Ponderosa and sugar pines are decreasing

Although no quantitative data are available, there is ample evidence that hardwood volume has increased during the past several decades. In much of the area, hardwoods such as California black oak, tanoak, and madrone occur naturally in conifer stands. Selective logging has often freed these hardwoods from competition by conifers, and some of the conifer stands that have been clearcut or burned have regrown to hardwoods. It is also evident from the common occurrence of large ponderosa and sugar pine stumps in stands now predominantly Douglas-fir, or more often white fir or incense-cedar, that the relative volume of ponderosa and sugar pines has decreased, and white fir and incense-cedar have increased.

---

[9] Statistics for 1953 are unpublished, on file at the Pacific Northwest Forest and Range Experiment Station, Portland, Oreg.

FOREST GROWTH AND MORTALITY

Annual growth is 246 million cubic feet

Total net annual growth in growing stock trees 5.0-inch d.b.h. and larger is 246.1 million cubic feet and in sawtimber trees 9.0 inches and larger, 1,254.8 million board feet (International 1/4-inch rule). About 92 percent of the cubic-foot growth is in conifers, largely white and red firs, Douglas-fir, and ponderosa and Jeffrey pines as shown in figure 32.

Annual mortality is 45 million cubic feet

Average annual mortality of trees 5.0 inches and larger for the 5-year period preceding the inventory was 44.9 million cubic feet; average annual mortality in sawtimber trees 9.0-inch d.b.h. and larger was 221.9 million board feet (International 1/4-inch rule). White and red firs, Douglas-fir, and ponderosa and Jeffrey pines accounted for 75 percent of the mortality (fig. 33). Sugar, white, and lodgepole pine mortality was proportionately higher than volume and growth in these species.

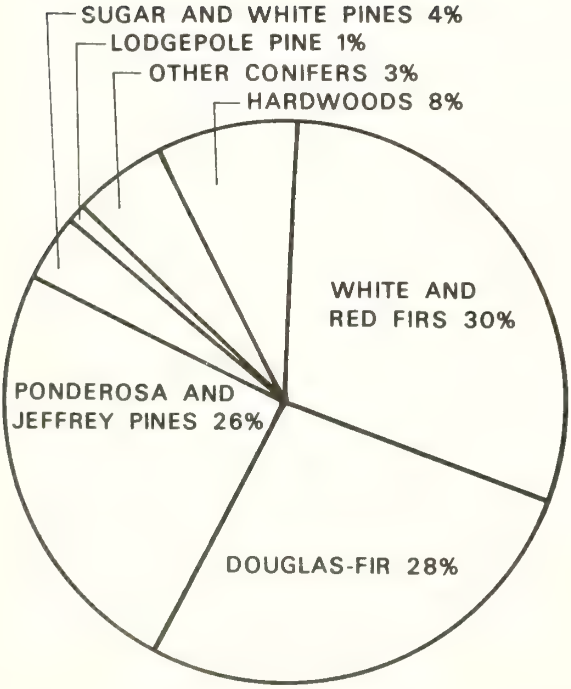


Figure 32.—Percent of net annual cubic-foot growth by species, California's Northern Interior, 1970.

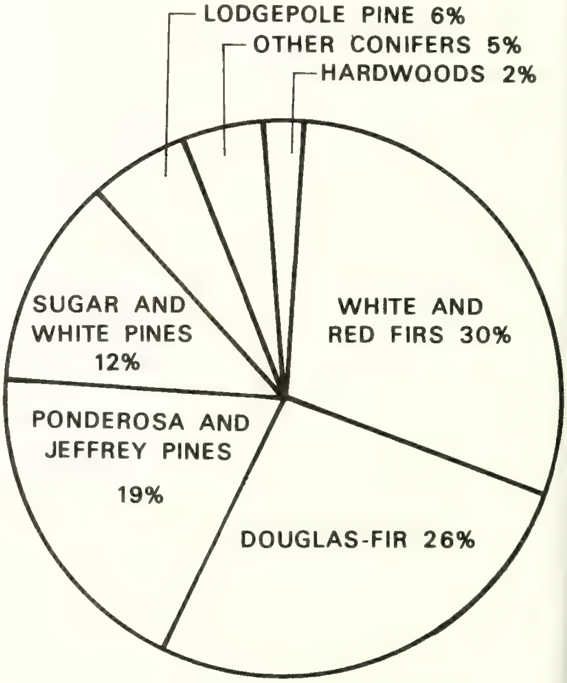


Figure 33.—Percent of annual mortality by sp cies, California's Northern Interior, 197

White and red firs, ponderosa and Jeffrey pines, and hardwoods have high growth rates relative to inventory volume, and lodgepole pine has a high mortality rate:

Species	Net annual cubic-foot growth as a percent of total species volume	Annual cubic-foot mortality as a percent of total species volume
Douglas-fir	1.2	0.2
White and red firs	1.9	.3
Ponderosa and Jeffrey pines	1.8	.2
Sugar and white pines	.8	.4
Lodgepole pine	1.3	1.7
Incense-cedar	1.2	.4
Other conifers	1.3	.2
Hardwoods	2.9	.1
All species	1.5	.3

The leading cause of mortality was insects

For all species, the leading direct cause of mortality was insects (31 percent),[10] followed by: weather (13 percent), disease (13 percent), fire and logging (5 percent), and suppression (4 percent). The remaining 34 percent is in unclassified causes such as landslides, exposure due to stand disturbance (logging, roadbuilding, etc.), changing water table, soil compaction; man's activities such as damage by vehicles (other than logging), fence building, etc; and probably some unrecognized suppression, insects, and disease.

Annual growth per acre in the Northern Interior averages 41 cubic feet, and mortality averages 7 cubic feet per acre, as shown in table 2.

---

[10] The Modoc budworn outbreak of 1974, which affected 231,000 acres of true fir in northern California and southern Oregon, is not reflected here, because it occurred after the field survey was completed.

Table 2--*Growth and mortality by ownership, California's Northern Interior, 1970*[1]

Ownership	Total net growth	Total mortality	Net annual growth per acre	Annual mortality per acre	Gross growth per acre
	Million cubic feet		*Cubic feet*		
National Forest	155.2	28.3	45	8	53
Other public	5.0	1.1	32	7	39
Forest industry	22.8	4.2	34	6	40
Farmer and miscellaneous private	63.1	11.3	37	7	44
All owners	246.1	44.9	41	7	48

[1] Growth and mortality were estimated over various periods of time for different portions of the forest. See "Inventory Procedures," page 72.

National Forests have highest per-acre growth rates and lowest mortality related to timber volume

Table 2 shows that National Forests have the highest net and gross per-acre growth rates, but also the highest per-acre mortality. National Forests have the lowest mortality rate in terms of percent of inventory volume:

Ownership	Mortality as a percent of total cubic-foot volume within ownership
National Forest	0.26
Other public	.40
Forest industry	.29
Farmer and miscellaneous private	.35
All ownerships	.28

On the surface it seems paradoxical that National Forests with lower average per-acre productive potential and much older timber than private ownerships should have higher growth and lower mortality rates. A comparison of the stocking figures (see page 22) only clouds the picture further, since private lands appear about as well stocked as National Forest lands.

A partial explanation of the mortality situation is simply that old-growth stands have lower mortality rates than young growth. Staebler (1955) found that in Douglas-fir in the Pacific Northwest

Mortality rates are higher in young stands

mortality culminates at about 80 to 90 years after which it drops off, and 60- to 70-year-old stands have higher mortality than stands of 130 years and over. A tabulation of volume and mortality by stand age groups in Lassen and Modoc Counties, where substantial areas of both young and old stands exist, suggests that these stands develop in a manner similar to Douglas-fir in the Pacific Northwest:

Stand age and ownership	Percent of total cubic-foot: Volume	Percent of total cubic-foot: Mortality
0-50 years		
National Forest	4	4
Other ownerships	8	21
50-100 years		
National Forest	42	56
Other ownerships	65	52
100 years and older		
National Forest	54	40
Other ownerships	27	27

The above data show that 46 percent of the volume on National Forests, but 60 percent of the mortality, is in stands less than 100 years old. For other ownerships, 73 percent of the volume and 73 percent of the mortality are in stands less than 100 years old. For all National Forests in the five-county area exclusive of the Klamath,[11] 66 percent of the volume, but only 54 percent of the mortality, was in trees 21.0 inches and larger.

The high mortality compared to volume in the 0- to 50-year age class on other ownerships—21 percent—suggests that something about these young stands is different from the 0- to 50-year stands on National Forests.

75 percent of private lands have been logged or burned

The plot data showed that about 75 percent of the commercial forest land in private ownership in the five-county area has been logged one to four times or burned in the past 100 years. The tree data from these plots indicated most areas were fairly well stocked but not with the best possible trees.

Lassen County growth compared with yield tables . . .

In an attempt to quantify objectively how younger stands and cutover areas are performing, the past 10-year periodic net annual growth for each stand sampled on private land in Lassen County was compared with the periodic net annual growth shown in yield tables. Lassen County was chosen because it has the greatest percentage of young stands and generally a longer history of cutting than other counties in the Northern Interior. For stands that were predominantly ponderosa or Jeffrey pines, Technical

---

[11] Data not available by diameter class.

Bulletin 630 (Meyer 1961) was used; for white fir stands, University of California Bulletin 407 (Schumacher 1926) was used. Site index was used to determine the basic productivity level, then was discounted to take care of stockability problems in the manner detailed in Research Paper PNW-152 (MacLean and Bolsinger 1973a). Stand age was assigned as the predominant age of the dominant and codominant trees. In a few stands consisting of young trees with a scattering of old residuals, the stand age chosen was that of the young trees. The difficulty in using this type of comparison is, of course, that many stands do not conform to yield table standards because of age spread, mixture of species, microsite inclusions, etc. Still, this analysis gives some ideas of how well stands are performing.

A total of 44 stands were examined. (See "Inventory Procedures," page 72, for details on plot selection.) The results:

- **Half of the stands are growing well**
- **About one-third are growing less than half of yield table growth rates**

Past 10-year periodic growth was equal to or greater than the yield table level for 41 percent of the stands, and 7 percent were less than 25 percent below the yield table level. This leaves 52 percent that were growing substantially below the yield table level, including 16 percent where yields were 50 to 76 percent of yield table levels, and 36 percent where yields were less than half of those indicated in yield tables.

Except for three nonstocked areas, there was no solid relationship between stocking and growth. A closer examination showed that many stands are stocked with poor timber-producing trees—slow-growing and vulnerable to insects, disease, and other mortality agents.

These conditions were noted:

1. Dwarf mistletoe infections were recorded in 40 percent of the stands, half of which were considered to be heavily infected. (The western-wide dwarf mistletoe rating system developed by Forest Service pathologists was used to score the seriousness of infections.) Dwarf mistletoe is a light-demanding organism and has apparently increased greatly due to the opening up of stands by logging, road-building, and thinning by man, as well as by storms, insects, and disease.

Mistletoe, top or bole damage, and low vigor are common

Past cutting left many stands with low growth and high mortality

2. Dead tops, top damage, and injuries due to logging and other mechanical factors were recorded in 64 percent of the stands sampled, though these agents usually affected less than 10 percent of any given stand.
3. Many trees left after logging were defective, poorly formed, and low in vigor, often suppressed before logging with little capacity to respond to release—since they can't respond, they often die. In many cases, trees were left standing simply because they had little market value. They often have little value in the woods as timber producers. These kinds of trees make up a small portion of undisturbed stands, but are significant in many residual stands because they control space where better trees could be growing. Many of these trees may be genetically inferior—leaving them as the major seed source may have resulted in genetic degradation of the younger stands now developing.

On the positive side, growth is increasing

A positive view of the forest situation is in order. Though many stands are growing much less wood annually than they could be, and total growth is currently about 30 percent less than the annual cut, there is ample evidence that growth is increasing. The current cutting rate of 1.3 billion board feet is reducing the inventory only 0.4 percent per year, whereas the average rate of decline between 1953 and 1970 was about 1.2 percent. Since the reported cut has remained nearly level, and no changes have been made in the scaling units, the improvement can be attributed only to an increase in net growth. Many cutover stands are beginning to recuperate.

The list of undesirable conditions that currently exist could be turned into a list of opportunities for increasing future growth rates. In fact many private landowners, particularly timber companies and certain large nontimber corporations, are now beginning to practice sound forestry (fig. 34). In the past, much of the private land was logged either with little regard for future timber production[12] or using methods which were sometimes destructive. The Z'Berg-Negedely Forest Practice Act of 1973 (California, State of, 1974) is aimed at assuring that the productivity of private forest lands is maintained.

---

[12] For example, between 1912 and 1944 all the timber was cut from about 760,000 acres of land belonging to the Red River Lumber Company in the Westwood area, after which the company sold its mill (Barrette and Lucke 1975).

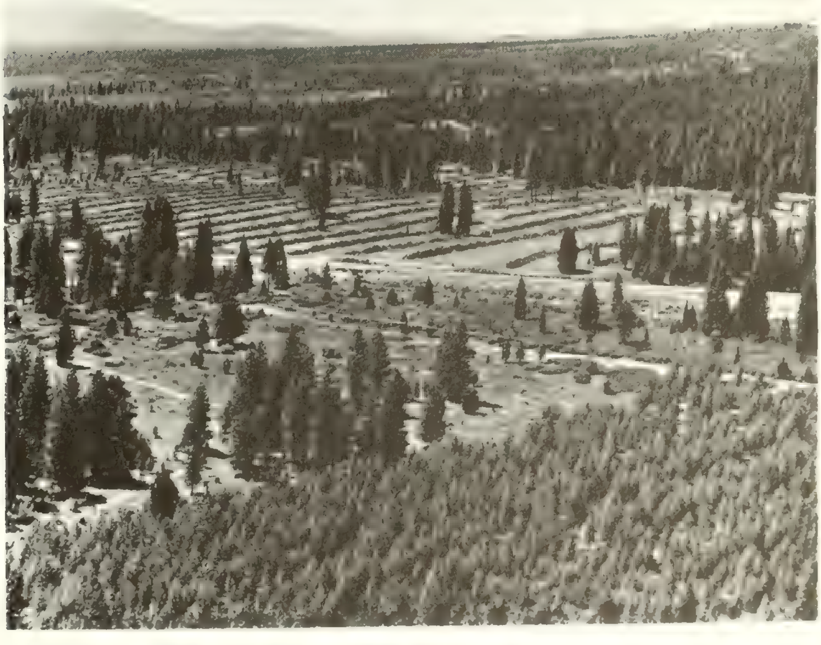


Figure 34.—Brush windrowing for tree planting, and older plantations on private timber company property, Siskiyou County.

National Forests in the Northern Interior also have had a long history of cutting[13] but not to the extent found on private lands. Though most National Forest timber cutting has been planned with the objective of sustaining timber production while protecting the soil and other resource values, not all management efforts have been successful. Knowledge of how to manage some lands is still lacking; and man is still unable to stop the devastation of storms and has only partial control over fire, insects, and disease.

Conditions should improve on both public and private lands

Many problems of forest management are currently the objects of research efforts in the Western States. Included are forest regeneration, insect and disease control, logging and roadbuilding methods, and forest soil fertility, to name a few, all problems in California's Northern Interior. Both private and public forest managers should be better equipped to cope with forestry problems in the future.

SALVABLE DEAD TIMBER

Salvable dead volume equals the annual cut, but salvage is difficult due to . . .

In the five-county area there is an estimated 911 million board feet (International 1/4-inch rule) in salvable dead trees 11.0 inches and larger. Slightly less than half of this is on National Forests. Some dead wood is salvaged each year. Much of the salvable dead material is not currently attractive to timber operators, however, and an unknown percentage of the dead trees is in inaccessible areas.

- **Scattered occurrence**
- **Low value of some of the material**
- **High deterioration of some**

Survey plot data show that much of the material is in low concentrations and presumably costly to log. Only 24 percent of the salvable dead volume is in concentrations of 5,000 or more board feet per acre, 23 percent is in concentrations of 2,000-4,999 board feet per acre, and 53 percent is in concentrations of less than 2,000 board feet per acre. There are also differences in deterioration rate by species, size, and cause of death which affect the degree to which dead trees are salvaged. Some species are low in desirability even when live and sound. Lodgepole pine, for example, has a lower market value than many species; because of its smaller size, checking and staining after death quickly reduce its value. This species accounts for 53 percent of the salvable dead volume on National Forests in Lassen and Modoc Counties. In general, Douglas-fir is the most durable after death. Ponderosa, Jeffrey, sugar, and white pines tend to become checked and blue stained; but the impact affects lumber grade more than quantity recovered and is less in larger trees. White and red firs deteriorate rapidly after death, especially if killed by windthrow, mechanical breakage, or bark beetles such as the common fir engraver (*Scolytus ventralis*).

---

[13] Nearly 1 billion board feet were sold in one timber sale on the Lassen National Forest in 1922, for example. This sale was logged over a 32-year period. Cutting varied from 70 percent of the total volume in early years to a very selective "high risk" cut in later years.

Over all ownerships in the five-county area, 38 percent of the salvable dead volume is Douglas-fir. Table 3 shows the distribution of the salvable dead volume.

Table 3--*Volume of salvable dead timber by species on National Forest and other public and private lands, California's Northern Interior, January 1, 1970*

Species	National Forest		Other public and private	
	Million board feet[1]	*Percent*	*Million board feet*[1]	*Percent*
Douglas-fir	230	50	119	26
Red and white firs	37	8	99	22
Ponderosa and Jeffrey pines	80	18	115	25
Sugar and white pines	52	12	80	17
Lodgepole pine	42	9	4	1
Incense-cedar	7	2	40	9
Hardwoods	5	1	1	--
Total	453	100	458	100

[1] International 1/4-inch rule.

TIMBER CUT

Northern Interior forests provide 27 percent of California's timber cut

In 1972 1.3 billion board feet (Scribner scale) of timber were cut in the Northern Interior. This was about 27 percent of the total cut in California. The Northern Interior has contributed 26 to 28 percent of the total cut in the State for several years. In 1946 and 1948, the Northern Interior cut was 32 percent of the State's total; but in 1955, it dropped to 23 percent, even though the total volume cut increased. This occurred because of the tremendous increase in cutting in the north coast counties (Oswald 1970) between 1946 and 1955.

The cut is shifting from private lands to National Forests

Since 1945, over 36 billion board feet (Scribner scale) of timber have been cut in the five-county area. Since 1953, the total cut has remained fairly constant, ranging between 1.3 and 1.5 billion board feet annually; but there has been a decided shift in the cut from private lands to public lands over this same period. (fig. 35) In 1955, about 80 percent of the cut came from private

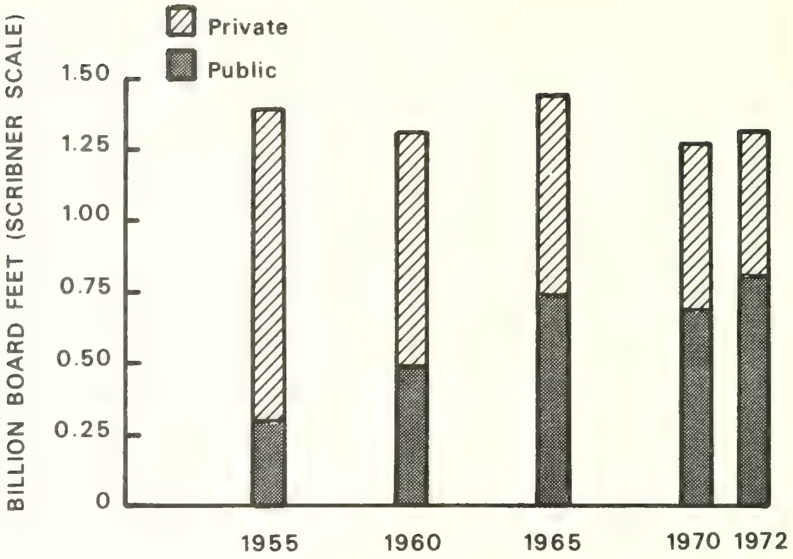


Figure 35.—Since 1955, public timber cut in California's Northern Interior has increased, and private timber cut has decreased.

lands and 20 percent from public lands (mostly National Forest). In 1972, 40 percent of the cut came from private lands and 60 percent from public lands. Private timber will contribute even a smaller proportion of the total cut in the near future because of the declining inventory and lower growth rates on private lands. A large portion of the remaining uncut old-growth timber in private ownership is in steep, unroaded areas. Accessibility and possibly restrictions due to environmental concerns are expected to limit the cutting rate in these remaining private old-growth stands. This situation could be altered slightly by some proposed land exchanges between the Forest Service and private corporations and by the development of improved methods of logging in steep, unstable country.

The cut has shifted from the east to the west—from Lassen and Modoc Counties to Siskiyou, Shasta, and Trinity

There has also been a shift in the cutting by county. Lassen County had the greatest cut in the Northern Interior in 1946, 1948, and 1949. In 1949, Lassen's cut of 340 million board feet was 32 percent of the total in the five-county area. In 1972 Lassen's cut was 98 million board feet, only 7 percent of the five-county total. A large drop in the cut in Lassen County between 1955 and 1956 has been associated with the closure of the Fruit Growers Supply Company mill at Westwood which for many years produced more lumber than any other sawmill in California. Modoc County's cut also dropped markedly in the early 1950's. For several years, Modoc County's cut amounted to 15 to 20 percent of the five-county total. In 1948 and 1950, the cut exceeded 200 million board feet; but in 1953, it dropped to 86 million. In 1972, Modoc County's cut of 99 million board feet was about 7 percent of the total in the Northern Interior. The decline in cutting, in both Lassen and Modoc Counties, corresponds to the depletion of accessible timber on private lands.

Trinity County is likely to contribute more timber in the future

During the period that timber cutting delcined in Lassen and Modoc Counties, it increased sharply in Siskiyou, Shasta, and Trinity Counties. In 1972, Siskiyou County led with 464 million board feet and Shasta County was second with 406 million. Trinity County's cut was 235 million. The tremendous volume of uncut timber in Trinity County, about 11 billion board feet more than in Shasta County, suggests Trinity's cut may surpass Shasta's. It is reasonable to expect the future timber cut to be concentrated in Siskiyou and Trinity Counties, which combined contain nearly 70 percent of the timber in the five-county area, followed by Shasta then Lassen and Modoc, in that order.

Cutting initially was concentrated in ponderosa and sugar pines . . .

Later in Douglas-fir

Cut is now increasing in true firs and incense-cedar

A considerable change in the mix of species cut has also occurred over the years in the Northern Interior. In 1946, 75 percent of the timber cut was ponderosa and sugar pines; the percentage of these species has steadily declined to 39 percent of the total cut in 1972. Douglas-fir amounted to 13 percent of the cut in 1946, increased to 34 percent by 1956, then declined to 27 percent in 1972. White and red firs have steadily increased from 11 percent of the cut in 1946 to 26 percent in 1972, and incense-cedar has increased from 1 percent in 1946 to 6 percent in 1972. These changes have occurred mainly because the more valuable pines were cut first in much of the accessible country, followed by Douglas-fir, leaving the lower value white fir and incense-cedar. Changing market conditions and recent road-building into the higher elevation forests are also factors, occurring concurrently with and partly because of the growing scarcity of pine and Douglas-fir in the more accessible areas. In much of the easily accessible country such as the private lands near Burney, the cutting history is clearly recorded in the stumps: the oldest stumps are nearly all pine, younger stumps include Douglas-fir, and the most recent stumps include a lot of white fir and incense-cedar.

The cut in ponderosa and sugar pines will continue to decline

More Douglas-fir and true firs will be cut in the future

Ponderosa, Jeffrey, and sugar pines will contribute proportionately less to the total cut in the foreseeable future. The cut is presently 70 percent greater than growth in these species, and the prospect for growth in the next several decades is less in pines than in Douglas-fir and true firs. The current volume in small ponderosa pine trees (5.0 to 10.9 inches d.b.h.) is 55 percent less than in Douglas-fir and 45 percent less than in white fir. Selection cutting in the mixed-conifer type continues to promote Douglas-fir and white fir, and Douglas-fir is the major softwood species restocking the clearcut patches in the extreme western portion of the Northern Interior, though pines are being planted in some logged areas.

Douglas-fir is currently being cut at a rate 13 percent greater than growth. The inventory is declining as old-growth stands are logged, but growth should increase in the future. Douglas-fir will contribute proportionately more to the total cut in the near future if the cut stays at current levels.

White and red firs are being cut at exactly their growth rate. They will also contribute proportionately more to the total cut in the near future.

Incense-cedar once had little value on the market because of limited use but is now being used for various purposes including interior decoration, rustic fences, and some construction. The current cutting rate of incense-cedar is three times the growth rate. No great increase in the future cut can be expected from this species, though the growth has apparently increased due to past timber cutting practices which have favored this species. In many stands heavier cutting of incense-cedar could promote the growth of more valuable species.

More lodgepole pine and other minor species could be cut

Lodgepole pine has been generally unused in the past, though in 1972 a small amount appeared in the consumption reports. Lodgepole pine, hardwoods, and minor conifers such as hemlock and knobcone pine account for about 41 million board feet or 4 percent of the growth per year, and could contribute to the total timber cut in a small way. However, much of the volume in these species is currently inaccessible and in concentrations too small for economic recovery.

In the near future, the softwood inventory will continue to decline, but . . .

The overall trend for the near future appears to be a continuing decline in the softwood inventory, but at a slackening rate as old-growth stands are cut out, young-growth stands develop, and growth increases in residual stands left after selective cutting. Improved utilization, of course, has resulted in some increase in wood supply, and this trend will continue.

It appears possible to maintain the current cutting level, if . . .

An annual cut of 1.3 billion board feet could be maintained indefinitely, it appears, if the 6 million acres of commercial forest land produced, instead of the current 173 board feet (41 cubic feet) per acre per year, an average of 216 board feet (51 cubic feet). This seems well within the capabilities of the area.

Growth could be increased 20-25 percent

More intensive forestry would be required

Forest management treatments have already been applied to some areas which will result in increased future growth. A much more concerted effort at all levels is necessary, however, if the growth rate is to be increased 20-25 percent. Such an increase would require that the land be restocked soon after logging, that losses from fires, insects, and disease be held to a minimum, and that leave trees not be damaged or destroyed in partial cutting. Stands would have to be upgraded by favoring the more vigorous trees of desirable species rather than the inferior trees and undesirable species such as hardwoods and incense-cedar. Land would have to be managed so that the soil itself is not damaged and that timber cutting is carefully scheduled to capture maximum growth.

In the long run the sustainable cutting level will be dictated by people's decisions more than by the biological potential of the forest.

LITERATURE CITED

Barrette, B. R., D. R. Gedney, and D. D. Oswald.
1970. California timber industries, 1968, mill characteristics and wood supply. Calif. Dep. Conserv. Div. For. 117 p. Sacramento, Calif.

Barrett, B. R., and Dean R. Lucke.
1975. The forest resource and timber industry of the North Cal-Neva resource conservation and development project. Calif. Div. For., USDA For. Serv., and Soil Conserv. Serv. 41 p. Sacramento, Calif.

Burks, George F., H. J. Vaux, R. H. May, and A. Simontacchi.
1948. Commodity production from commercial forest land in California, 1946. USDA For. Serv. Calif. For. & Range Exp. Stn. For. Surv. Release 6, 38 p. Berkeley, Calif.

California Department of Human Resources Development.
1971. California employment and payrolls. Rep. 127. Sacramento, Calif.

California Division of Forestry.
1947-73. Production of California timber operators. State For. Notes. (Annu. publ.) Sacramento, Calif.

California, State of.
1974. California Administrative Code, Title 14, Div. 2, Ch. 2; Art. 4, Div. 4, Ch. 8. Public Resources Code.

Detling, LeRoy E.
1961. The chaparral formation of southwestern Oregon, with consideration of its postglacial history. Ecology 42: 348-357.

Howard, James O.
1974. California forest industry—wood consumption characteristics, 1972. USDA For. Serv. Resour. Bull. PNW-52, 91 p. Pac. Northwest For. & Range Exp. Stn., Portland, Oreg.

MacLean, Colin D., and Charles L. Bolsinger.
1973a. Estimating productivity on sites with a low stocking capacity. USDA For. Serv. Res. Pap. PNW-152, 18 p. Pac. Northwest For. & Range Exp. Stn., Portland, Oreg.

MacLean, Colin D., and Charles L. Bolsinger.
1973b. Estimating Dunning's site index from plant indicators. USDA For. Serv. Res. Note PNW-197, 10 p. Pac. Northwest For. & Range Exp. Stn., Portland, Oreg.

May, Richard H.
1953. A century of lumber production in California and Nevada. USDA For. Serv. Calif. For. & Range Exp. Stn. For. Surv. Release 20, 33 p. Berkeley, Calif.

May, Richard H.
1958. Development of the veneer and plywood industry in California. USDA For. Serv. Calif. For. & Range Exp. Stn. For. Surv. Release 34, 26 p. Berkeley, Calif.

May, Richard H., and Harold Baker.
1957. Lumber production in California, 1956. USDA For. Serv. Calif. For. & Range Exp. Stn. For. Surv. Release 30, 15 p. Berkeley, Calif.

May, Richard H., and Harold Baker.
1958. Output of timber products in California, 1956. USDA For. Serv. Calif. For. & Range Exp. Stn. For. Surv. Release 35, 35 p. Berkeley, Calif.

Meyer, Walter H.
1961. Yield of even-aged stands of ponderosa pine. U.S. Dep. Agric. For. Serv. Tech. Bull. 630. 59 p.

Muerle, G. F., and E. M. Hornibrook.
1965. Timber harvest in California, 1962. USDA For. Serv. Resour. Bull. PSW-2, 29 p. Pac. Southwest For. & Range Exp. Stn., Berkeley, Calif.

Munz, Philip A., and David D. Keck.
1970. A California flora. 1,681 p. Univ. Calif. Press, Berkeley.

Oswald, Daniel D.
1970. California forest industries—prospects for the future. USDA For. Serv. Resour. Bull. PNW-35, 55 p. Pac. Northwest For. & Range Exp. Stn., Portland, Oreg.

Oswald, Daniel D., and E. M. Hornibrook.
1966. Commercial forest area and timber volume in California, 1963. USDA For.

Serv. Resour. Bull. PSW-4, 16 p. Pac. Southwest For. & Range Exp. Stn., Berkeley, Calif.

Sargent, Charles S.
1884. Report on the forests of North America (exclusive of Mexico). Tenth Census of the United States—1880. Vol. IX. 612 p. Dep. Int. Census Off.

Schumacher, Francis X.
1926. Yield, stand, and volume tables for white-fir in the California pine region. Bull. 407. 26 p. Univ. Calif. Coll. Agric., Berkeley, Calif.

Staebler, George R.
1955. Gross yield and mortality tables for fully stocked stands of Douglas-fir. USDA For. Serv. Pac. Northwest For. & Range Exp. Stn. Res. Pap. No. 14, 20 p. Portland, Oreg.

U.S. Department of Agriculture, Forest Service.
1954. Forest statistics for California. For. Serv. Calif. For. & Range Exp. Stn. For. Surv. Release 25, 66 p. Berkeley, Calif.

U.S. Office of Management and Budget.
1972. Standard Industrial Classification Manual, 1972. 649 p.

Whittaker, R. H.
1960. Vegetation of the Siskiyou Mountains, Oregon and California. Ecol. Monogr. 30: 279-338.

REFERENCES

Baker, Harold L., and Adon Poli.
1951. Area and ownership of forest land in Trinity County, California. USDA For. Serv. Calif. For. & Range Exp. Stn. For. Surv. Release 9, 23 p. Berkeley, Calif.

Baker, Harold L., and Adon Poli.
1954. Area and ownership of forest land in Shasta County, California. USDA For. Serv. Calif. For. & Range Exp. Stn. For. Surv. Release 24, 24 p. Berkeley, Calif.

Burks, George F., and Adon Poli.
1950. Area and ownership of forest land in Siskiyou County, California. USDA For. Serv. Calif. For. & Range Exp. Stn. For. Surv. Release 8, 23 p. Berkeley, Calif.

Greely, W. B., Earle H. Clapp, Herbert A. Smith, and others.
1923. Timber—mine or crop? U.S. Dep. Agric. Yearb. Dep. Agric., 1922, 98 p.

Griffin, James R.
1967. Soil moisture and vegetation patterns in northern California forests. USDA For. Serv., Res. Pap. PSW-46, 22 p. Pac. Southwest For. & Range Exp. Stn., Berkeley, Calif.

Hutchinson, W. H.
1957. California heritage—a history of northern California lumbering. 32 p. Diamond Gardner Corp., Chico, Calif.

Kellogg, R. S.
1909. The timber supply of the United States. U.S. Dep. Agric. For. Serv., Circ. 166, 39 p.

Little, Elbert L., Jr.
1953. Check list of native and naturalized trees of the United States (including Alaska). U.S. Dep. Agric. Agric. Handbk. 41, 472 p.

MacLean, Colin D., and Charles L. Bolsinger.
1974. Stockability equations for California forest land. USDA For. Serv. Res. Note PNW-233, 10 p. Pac. Northwest For. & Range Exp. Stn., Portland, Oreg.

U.S. Congress.
1932. Copeland resolution report—Senate resolution 175. 72d Congr., 1st sess.

U.S. Department of Agriculture, Forest Service.
1920. Timber depletion, lumber prices, lumber exports, and concentration of timber ownership—report on Senate resolution 311. 71 p.

U.S. Department of Agriculture, Forest Service.
1973. The outlook for timber in the United States. U.S. Dep. Agric. For. Serv., For. Resour. Rep. 20. 367 p.

Waring, R. H.
1969. Forest plants of the eastern Siskiyous, their environmental and vegetational distribution. Northwest Sci. 43: 1-17.

Wieslander, A. E., and Herbert A. Jensen.
1946. Forest areas, timber volumes and vegetation types in California. USDA For. Serv. Calif. For. & Range Exp. Stn. For. Surv. Release 4, 66 p. Berkeley, Calif.

TABLES

Table 4--*Area by land class and county, California's Northern Interior, January 1, 1970*

(In thousand acres)

Land class	All counties	Lassen	Modoc	Siskiyou	Shasta	Trinity
Forest land:						
Commercial	6,028	725	614	2,188	1,223	1,278
Productive-reserved	439	26	21	165	68	159
Unproductive	3,211	489	609	860	823	430
Total	9,678	1,240	1,244	3,213	2,114	1,867
Nonforest land[1]	4,313	1,679	1,366	795	314	159
Total area[2]	13,991	2,919	2,610	4,008	2,428	2,026

[1] Includes cropland, pasture and range, swampland, industrial and urban areas, powerline clearings, railroads, all improved roads and highways, and 49,191 acres classified as water by Forest Survey standards but defined by the Bureau of the Census as land.

[2] Source: U.S. Bureau of the Census, Land and Water Area of the United States, 1971.

Table 5--*Area of commercial forest land, by ownership class and county, California's Northern Interior, January 1, 1970*

(In thousand acres)

Ownership class	All counties	Lassen	Modoc	Siskiyou	Shasta	Trinity
National Forest	3,474	395	434	1,453	374	818
Other public:						
Bureau of Land Management[1]	115	14	2	17	42	40
Bureau of Indian Affairs[1]	1	(2)	(2)	--	(2)	1
Miscellaneous Federal[1]	21	--	--	7	13	1
State[1]	14	1	--	--	11	2
County and municipal[1]	3	--	--	--	1	2
Total other public	154	15	2	24	67	46
Private:						
Forest industry	679	40	22	310	231	76
Farmer-owned	444	19	8	230	94	93
Miscellaneous private--corporate	1,125	238	148	161	389	189
Miscellaneous private--noncorporate	152	18	--	10	68	56
Total private	2,400	315	178	711	782	414
All ownerships	6,028	725	614	2,188	1,223	1,278

[1] Area of commercial forest land in specific other public ownerships was determined by proportioning the estimated total area in "Other public" ownership by number of photo plots in each ownership.

[2] Less than 500 acres.

Table 6--*Area of commercial forest land, by ownership and stand-size classes, California's Northern Interior, January 1, 1970*

(In thousand acres)

Stand-size class	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Sawtimber stands:					
Large sawtimber[1]	2,645	2,001	20	217	407
Small sawtimber[2]	1,858	777	64	239	778
Total	4,503	2,778	84	456	1,185
Poletimber stands	399	216	20	51	112
Sapling and seedling stands	722	261	25	132	304
Nonstocked areas	404	219	25	40	120
All Classes	6,028	3,474	154	679	1,721

[1] Large sawtimber includes trees 21.0- inch d.b.h. and larger.

[2] Small sawtimber includes softwood trees 9.0- to 20.9-inch d.b.h. and hardwood trees 11.0- to 20.9-inch d.b.h.

Table 7--*Area of commercial forest land, by ownership and cubic-foot site classes, California's Northern Interior, January 1, 1970*

(In thousand acres)

Site class[1] (cubic feet)	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
165-224	282	157	2	44	79
120-164	555	283	13	111	148
85-119	1,194	715	23	165	291
50-84	2,639	1,763	57	195	624
20-49	1,358	556	59	164	579
All Classes	6,028	3,474	154	679	1,721

[1] A classification in terms of capacity for cubic-foot annual growth per acre at culmination of mean annual growth in fully-stocked stands.

Table 8--*Area of commercial forest land by stocking class of all growing-stock trees and ownership class, California's Northern Interior, January 1, 1970*

(In thousand acres)

Stocking percent[1]	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
80+	444	308	7	38	91
60-79	1,788	1,045	30	221	492
36-59	2,121	1,195	57	201	668
11-35	1,271	707	35	179	350
0-10	404	219	25	40	120
Total	6,028	3,474	154	679	1,721

[1] See "Definition of Terms," page 73.

Table 9--*Area of commercial forest land, by forest type and ownership class, California's Northern Interior, January 1, 1970*

(In thousand acres)

Forest type	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Douglas-fir	1,526	1,070	38	122	296
White fir	1,185	612	15	206	352
Red fir[1]	158	95	--	20	43
Ponderosa pine	1,201	679	17	144	361
Jeffrey pine	350	247	3	23	77
Sugar pine	67	43	--	10	14
Western white pine	11	7	--	--	4
Lodgepole pine	77	42	--	13	22
Knobcone pine	8	8	--	--	--
Brewer spruce	3	3	--	--	--
Mountain hemlock	8	8	--	--	--
Incense-cedar	321	101	2	66	152
Port-Orford-cedar	6	6	--	--	--
California black oak	194	63	29	4	98
Oregon white oak	60	7	6	5	42
Pacific madrone	28	17	--	5	6
Other commercial hardwoods	373	231	19	21	102
Noncommercial conifers	16	9	--	--	7
Noncommercial hardwoods	32	7	--	--	25
Nonstocked	404	219	25	40	120
All types	6,028	3,474	154	679	1,721

[1] Includes California red fir and Shasta red fir.

Table 10--*Area of noncommercial forest land by ownership class and forest type and land class, California's Northern Interior, January 1, 1970*

(In thousand acres)

Land class and forest type	All ownerships	National Forest	Other public	Forest industry[1]	Farmer and miscellaneous private[1]
RESERVED[2]					
Productive:					
Douglas-fir	63	61	2	--	--
True fir	212	166	46	--	--
Ponderosa pine	106	101	5	--	--
Jeffrey pine	11	--	11	--	--
Western white pine	15	13	2	--	--
Lodgepole pine	27	15	12	--	--
Mountain hemlock	4	--	4	--	--
Aspen	([3])	--	([3])	--	--
California black oak	1	--	1	--	--
Total	439	356	83	--	--
Unproductive:					
Douglas-fir	1	--	1	--	--
Ponderosa pine	1	--	1	--	--
Digger pine	([3])	--	([3])	--	--
Oak	37	37	([3])	--	--
Juniper	8	--	8	--	--
Chaparral	18	18	([3])	--	--
Noncommercial conifer	19	19	--	--	--
Low site	([3])	--	([3])	--	--
Unclassified	84	84	--	--	--
Total	168	158	10	--	--
Total reserved	607	514	93	--	--
UNRESERVED-UNPRODUCTIVE					
Rocky	468	362	11	19	76
Low site	624	386	49	4	185
Juniper	979	325	322	9	323
Oak-madrone	521	28	63	6	424
Chaparral	271	133	37	7	94
Critical watershed	27	27	--	--	--
Adverse location	54	54	--	--	--
Subalpine	87	87	--	--	--
Willow	8	--	--	--	8
Other	4	4	--	--	--
Total unreserved	3,043	1,406	482	45	1,110

[1] No privately owned productive forest lands were identified as reserved.

[2] See "Inventory Procedures," page 72, for source of data.

[3] Less than 500 acres.

Table 11--Area of commercial forest land and volume of growing stock and sawtimber, by stand-age and ownership classes, California's Northern Interior, January 1, 1970

Stand-age class (years)	All ownerships			National Forest			Other public			Forest industry			Farmer and miscellaneous private		
	Area	Growing stock	Saw-timber	Area	Growing stock	Saw-timber	Area	Growing stock	Saw-timber	Area	Growing stock	Saw-timber	Area	Growing stock	Saw-timber
	Thousand acres	*Million cubic feet*	*Million board feet*[1]	*Thousand acres*	*Million cubic feet*	*Million board feet*[1]	*Thousand acres*	*Million cubic feet*	*Million board feet*[1]	*Thousand acres*	*Million cubic feet*	*Million board feet*[1]	*Thousand acres*	*Million cubic feet*	*Million board feet*[1]
Nonstocked	404	49	217	219	27	136	25	1	1	40	10	27	120	11	53
0 - 9	258	179	955	105	64	337	10	2	10	35	17	96	108	96	512
10 - 19	121	69	298	16	17	66	3	1	2	25	16	81	77	35	149
20 - 29	87	76	357	38	34	148	--	--	--	9	4	15	40	38	194
30 - 39	127	117	321	63	78	216	6	5	14	17	10	28	41	24	63
40 - 49	204	313	1,284	153	230	952	2	(2)	--	4	19	83	45	64	249
50 - 59	179	363	1,600	96	157	644	6	22	83	30	74	351	47	110	522
60 - 69	143	252	993	58	121	520	20	36	149	20	45	186	45	50	138
70 - 79	97	251	1,120	41	95	388	6	11	43	15	37	175	35	108	514
80 - 89	75	190	899	12	39	194	5	5	30	18	19	69	40	127	606
90 - 99	80	195	917	14	32	96	11	49	297	14	17	66	41	97	458
100 - 119	22	101	522	13	41	210	--	--	--	--	--	--	9	60	312
120 - 139	22	104	675	13	26	144	--	--	--	--	--	--	9	78	531
140 - 159	23	65	351	18	46	241	--	--	--	--	--	--	5	19	110
160 - 179	18	41	247	9	31	189	--	--	--	--	--	--	9	10	58
180 - 199	6	6	28	6	6	28	--	--	--	--	--	--	--	--	--
200 and over	343	1,958	12,385	281	1,675	10,529	--	--	--	7	47	311	55	236	1,545
Uneven-aged under rotation age	2,234	4,506	23,134	1,134	2,817	13,846	48	84	464	316	553	3,270	736	1,052	5,554
Uneven-aged over rotation age	1,585	7,066	39,710	1,185	5,390	31,426	12	55	227	129	581	2,796	259	1,040	5,261
All classes	6,028	15,901	86,013	3,474	10,926	60,310	154	271	1,320	679	1,449	7,554	1,721	3,255	16,829

[1] International 1/4-inch rule.

[2] Less than 500,000 cubic feet.

[3] Rotation age as used here: Lodgepole pine--100 years; other conifers, Shasta, Trinity, and western Siskiyou Counties--100 years; other conifers, Lassen, Modoc, and eastern Siskiyou Counties--140 years; hardwoods--50 years.

Table 12--*Net volume of growing stock and sawtimber on commercial forest land, by ownership class and by softwoods and hardwoods, California's Northern Interior, January 1, 1970*

Ownership classes	Average volume per acre	All species	Softwoods	Hardwoods
	Cubic feet	- - - -	*-Million cubic feet-*	- - - -
Growing stock:[1]				
National Forest	3,145	10,926	10,509	417
Other public	1,760	271	247	24
Forest industry	2,134	1,449	1,400	49
Farmer and miscellaneous private	1,891	3,255	3,062	193
All ownerships	2,638	15,901	15,218	683
	Board feet	- - - -	*-Million board feet-*	- - - -
Sawtimber (International 1/4-inch rule):[2]				
National Forest	17,360	60,310	59,621	689
Other public	8,571	1,320	1,286	34
Forest industry	11,125	7,554	7,446	108
Farmer and miscellaneous private	9,779	16,829	16,416	413
All ownerships	14,269	86,013	84,769	1,244
Sawtimber (Scribner rule):[3]				
National Forest	15,790	54,856	54,182	674
Other public	7,026	1,082	1,049	33
Forest industry	9,666	6,563	6,457	106
Farmer and miscellaneous private	8,278	14,247	13,841	406
All ownerships	12,732	76,748	75,529	1,219

[1] Includes trees 5.0-inch d.b.h. and larger.

[2] Includes softwood trees 9.0-inch d.b.h. and larger, and hardwood trees 11.0-inch d.b.h. and larger.

[3] Includes trees 11.0-inch d.b.h. and larger.

Table 13--*Net volume of growing stock and sawtimber on commercial forest land by county and ownership class, California's Northern Interior, January 1, 1970*

County	Total	National Forest	Other public	Forest industry	Farmer and miscellaneous private
	- - - - - - - -	- - - - - *Million*	*cubic feet* - - - - -	- - - - - - - -	- - - - - - - -
Growing stock:[1]					
Lassen	1,470	918	15	84	453
Modoc	933	688	3	37	205
Shasta	2,787	1,100	85	576	1,026
Siskiyou	5,997	4,867	23	534	573
Trinity	4,714	3,353	145	218	998
Total	15,901	10,926	271	1,449	3,255
	- - - - - - - -	- - - - - *Million*	*board feet* - - - - -	- - - - - - - -	- - - - - - - -
Sawtimber (International 1/4-inch rule):[2]					
Lassen	7,560	4,879	76	409	2,196
Modoc	4,626	3,528	14	189	895
Shasta	15,064	5,886	373	3,244	5,561
Siskiyou	32,185	26,957	85	2,528	2,615
Trinity	26,578	19,060	772	1,184	5,562
Total	86,013	60,310	1,320	7,554	16,829
	- - - - - - - -	- - - - - *Million*	*board feet* - - - - -	- - - - - - - -	- - - - - - - -
Sawtimber (Scribner rule):[3]					
Lassen	6,299	4,242	60	292	1,705
Modoc	3,829	2,991	10	162	666
Shasta	12,984	5,239	292	2,732	4,721
Siskiyou	29,588	24,761	78	2,361	2,388
Trinity	24,048	17,623	642	1,016	4,767
Total	76,748	54,856	1,082	6,563	14,247

[1] Includes trees 5.0-inch d.b.h. and larger.

[2] Includes softwood trees 9.0-inch d.b.h. and larger, and hardwood trees 11.0-inch d.b.h. and larger.

[3] Includes trees 11.0-inch d.b.h. and larger.

Table 14--*Net volume of growing stock and sawtimber on commercial forest land, by stand-size class and by softwoods and hardwoods, California's Northern Interior, January 1, 1970*

Stand-size class	Average volume per acre	All species	Softwoods	Hardwoods
	Cubic feet	- - - - - - - *Million cubic feet* - - - - - - -		
Growing stock:[1]				
Large sawtimber stands	4,151	10,980	10,628	352
Small sawtimber stands	2,142	3,979	3,729	250
Poletimber stands	1,015	405	355	50
Sapling and seedling stands	676	488	457	31
Nonstocked areas	121	49	49	([4])
Total	2,638	15,901	15,218	683
	Board feet	- - - - - - - *Million board feet* - - - - - - -		
Sawtimber (International 1/4-inch rule):[2]				
Large sawtimber stands	24,457	64,688	64,012	676
Small sawtimber stands	9,502	17,654	17,170	484
Poletimber stands	2,699	1,077	1,045	32
Sapling and seedling stands	3,292	2,377	2,325	52
Nonstocked areas	537	217	217	--
Total	14,269	86,013	84,769	1,244
Sawtimber (Scribner rule):[3]				
Large sawtimber stands	22,498	59,506	58,843	663
Small sawtimber stands	7,631	14,178	13,704	474
Poletimber stands	2,028	809	778	31
Sapling and seedling stands	2,857	2,063	2,012	51
Nonstocked areas	475	192	192	--
Total	12,732	76,748	75,529	1,219

[1] Includes trees 5.0-inch d.b.h. and larger.

[2] Includes softwood trees 9.0-inch d.b.h. and larger, and hardwood trees 11.0-inch d.b.h. and larger.

[3] Includes trees 11.0-inch d.b.h. and larger.

[4] Less than 500,000 cubic feet.

Table 15--Net volume of growing stock on commercial forest land, by species and diameter class, California's Northern Interior, January 1, 1970

(In million cubic feet)

Species	Diameter class (inches at breast height)											
	All classes	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger
Softwoods:												
Douglas-fir	5,801	103	158	192	200	226	244	239	227	857	1,260	2,095
White fir	3,180	94	141	190	207	215	211	205	194	712	696	315
Red fir[1]	666	11	13	21	25	32	43	48	49	179	156	89
Ponderosa pine	2,801	66	100	127	140	160	155	160	161	608	618	506
Jeffrey pine	703	16	21	31	39	42	39	38	48	166	165	98
Sugar pine	1,197	8	11	13	19	20	28	40	42	199	281	536
Western white pine	62	1	1	2	2	3	4	6	4	20	17	2
Lodgepole pine	165	11	18	22	28	20	16	12	12	20	6	--
Knobcone pine	38	1	1	3	3	13	7	4	2	4	--	--
Brewer spruce	6	--	(2)	(2)	1	1	--	--	1	1	2	--
Mountain hemlock	40	2	2	5	6	5	3	4	1	7	5	--
Incense-cedar	531	20	26	21	23	31	26	28	33	118	117	88
Port-Orford-cedar	19	(2)	(2)	--	2	(2)	1	2	(2)	7	5	2
Western redcedar	9	--	--	--	--	1	(2)	--	(2)	2	4	2
Total	15,218	333	492	627	695	769	777	786	774	2,900	3,332	3,733
Hardwoods:												
California black oak	261	25	30	22	20	26	19	20	18	49	26	6
Oregon white oak	41	6	7	3	5	4	1	3	3	6	3	--
Tanoak	95	6	11	16	10	6	7	5	7	21	3	3
Pacific madrone	126	8	19	15	14	12	14	10	10	19	4	1
Canyon live oak[3]	117	16	21	19	13	10	7	7	6	13	5	(2)
Other commercial hardwoods[4]	43	5	6	5	4	5	5	2	1	4	4	2
Total	683	66	94	80	66	63	53	47	45	112	45	12
All species	15,901	399	586	707	761	832	830	833	819	3,012	3,377	3,745

[1] Includes California red fir and Shasta red fir.

[2] Less than 500,000 cubic feet.

[3] Includes golden chinquapin.

[4] Primarily white alder, Fremont cottonwood, quaking aspen, and bigleaf maple.

Table 16--Net volume of sawtimber on commercial forest land, by species and diameter class, California's Northern Interior, January 1, 1970 (International ¼-inch rule)

(In million board feet)

Species	Diameter class (inches at breast height)									
	All classes	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger
Softwoods:										
Douglas-fir	33,627	408	704	956	1,137	1,207	1,223	5,190	8,266	14,536
White fir	17,417	503	940	1,146	1,190	1,162	1,117	4,473	4,696	2,190
Red fir[1]	3,757	42	115	160	228	259	274	1,062	1,006	611
Ponderosa pine	14,856	383	525	658	669	751	803	3,459	4,022	3,586
Jeffrey pine	3,707	115	158	174	174	169	236	923	1,061	697
Sugar pine	7,503	26	64	97	144	215	241	1,201	1,811	3,704
Western white pine	344	(2)	8	12	20	34	24	122	108	16
Lodgepole pine	518	39	90	77	65	54	58	103	32	--
Knobcone pine	104	1	9	38	24	15	10	7	--	--
Brewer spruce	29	--	2	2	--	--	3	8	14	--
Mountain hemlock	154	3	23	19	7	26	8	40	28	--
Incense-cedar	2,595	79	120	146	117	132	165	638	681	517
Port-Orford-cedar	105	--	5	1	3	5	1	44	30	16
Western redcedar	53	--	--	3	1	--	2	7	26	14
Total	84,769	1,599	2,763	3,489	3,779	4,029	4,165	17,277	21,781	25,887
Hardwoods:										
California black oak	528	--	39	56	47	51	51	154	98	32
Oregon white oak	61	--	12	7	5	5	6	18	8	--
Tanoak	161	--	18	14	18	15	20	59	9	8
Pacific madrone	200	--	30	29	30	24	24	50	12	1
Canyon live oak[3]	198	--	30	27	19	28	19	52	21	2
Other commercial hardwoods[4]	96	--	9	13	20	8	7	14	20	5
Total	1,244	--	138	146	139	131	127	347	168	48
All species	86,013	1,599	2,901	3,635	3,918	4,160	4,292	17,624	21,949	25,935

[1] Includes California red fir and Shasta red fir.
[2] Less than 500,000 board feet.
[3] Includes golden chinquapin.
[4] Primarily white alder, Fremont cottonwood, quaking aspen, and bigleaf maple.

Table 17--Net volume of sawtimber on commercial forest land, by species and diameter class, California's Northern Interior, January 1, 1970 (Scribner rule)

(In million board feet)

Species	Diameter class (inches at breast height)									
	All classes	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger
Softwoods:										
Douglas-fir	30,673	--	537	750	919	1,005	1,046	4,653	7,756	14,007
White fir	14,863	--	711	899	962	963	950	3,963	4,342	2,073
Red fir[1]	3,342	--	90	130	188	224	242	959	936	573
Ponderosa pine	13,212	--	280	473	548	653	721	3,232	3,840	3,465
Jeffrey pine	3,259	--	71	118	138	149	212	872	1,024	675
Sugar pine	6,926	--	41	67	110	174	200	1,067	1,701	3,566
Western white pine	293	--	5	9	15	27	19	105	102	16
Lodgepole pine	414	--	72	64	54	48	51	95	30	--
Knobcone pine	86	--	6	31	21	13	8	7	--	--
Brewer spruce	26	--	2	1	--	--	3	7	13	--
Mountain hemlock	122	--	14	13	5	20	7	37	26	--
Incense-cedar	2,161	--	71	101	88	104	136	556	625	480
Port-Orford-cedar	97	--	4	1	2	5	2	40	28	15
Western redcedar	50	--	--	3	2	--	1	7	24	13
Total	75,529	--	1,904	2,660	3,052	3,385	3,598	15,600	20,447	24,883
Hardwoods:										
California black oak	520	--	38	55	46	51	50	151	97	32
Oregon white oak	58	--	11	7	4	5	6	17	8	--
Tanoak	157	--	18	13	18	15	19	57	9	8
Pacific madrone	195	--	29	28	29	23	23	50	12	1
Canyon live oak[2]	196	--	29	28	18	27	19	52	21	2
Other commercial hardwoods[3]	93	--	8	11	19	8	7	15	20	5
Total	1,219	--	133	142	134	129	124	342	167	48
All species	76,748	--	2,037	2,802	3,186	3,514	3,722	15,942	20,614	24,931

[1] Includes California red fir and Shasta red fir.
[2] Includes golden chinquapin.
[3] Primarily white alder, Fremont cottonwood, quaking aspen, and bigleaf maple.

Table 18--*Net volume of growing stock on commercial forest land by species and ownership class, California's Northern Interior, January 1, 1970*

(In million cubic feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	5,801	4,519	153	318	811
White fir[1]	3,180	1,974	20	456	730
Red fir[2]	666	448	2	23	193
Ponderosa pine	2,801	1,672	49	353	727
Jeffrey pine	703	521	8	39	135
Sugar pine	1,197	880	10	98	209
Western white pine	62	48	--	2	12
Lodgepole pine	165	119	3	10	33
Knobcone pine	38	22	1	9	6
Brewer spruce	6	4	--	2	--
Mountain hemlock	40	39	--	1	([3])
Incense-cedar	531	235	1	89	206
Port-Orford-cedar	19	19	--	--	--
Western redcedar	9	9	--	--	--
Total	15,218	10,509	247	1,400	3,062
Hardwoods:					
California black oak	261	109	12	32	108
Oregon white oak	41	14	2	2	23
Tanoak	95	93	--	--	2
Pacific madrone	126	104	1	7	14
Canyon live oak[4]	117	77	8	6	26
Other commercial hardwoods[5]	43	20	1	2	20
Total	683	417	24	49	193
All species	15.901	10,926	271	1,449	3,255

[1] Includes small amount of grand fir.
[2] Includes California red fir and Shasta red fir.
[3] Less than 500,000 cubic feet.
[4] Includes golden chinquapin.
[5] Primarily white alder, Fremont cottonwood, quaking aspen, and bigleaf maple.

Table 19--*Net volume of sawtimber on commercial forest land, by species and ownership class, California's Northern Interior, January 1, 1970 (International 1/4-inch rule)*

(In million board feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	33,627	26,715	801	1,723	4,388
White fir[1]	17,417	10,683	106	2,471	4,157
Red fir[2]	3,757	2,584	11	104	1,058
Ponderosa pine	14,856	9,090	247	1,864	3,655
Jeffrey pine	3,707	2,752	45	179	731
Sugar pine	7,503	5,572	57	590	1,284
Western white pine	344	271	--	11	62
Lodgepole pine	518	370	14	39	95
Knobcone pine	104	63	--	31	10
Brewer spruce	29	25	--	4	--
Mountain hemlock	154	148	--	3	3
Incense-cedar	2,595	1,190	5	427	973
Port-Orford-cedar	105	105	--	--	--
Western redcedar	53	53	--	--	--
Total	84,769	59,621	1,286	7,446	16,416
Hardwoods:					
California black oak	528	202	16	70	240
Oregon white oak	61	16	2	3	40
Tanoak	161	156	--	--	5
Pacific madrone	200	159	1	17	23
Canyon live oak[3]	198	122	12	13	51
Other commercial hardwoods[4]	96	34	3	5	54
Total	1,244	689	34	108	413
All species	86,013	60,310	1,320	7,554	16,829

---

[1] Includes small amount of grand fir.

[2] Includes California red fir and Shasta red fir.

[3] Includes golden chinquapin.

[4] Primarily white alder, Fremont cottonwood, quaking aspen, and bigleaf maple.

Table 20--*Net volume of sawtimber on commercial forest land, by species and ownership class, California's Northern Interior, January 1, 1970 (Scribner rule)*

(In million board feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
oftwoods:					
Douglas-fir	30,673	24,854	653	1,492	3,674
White fir[1]	14,863	9,197	84	2,100	3,482
Red fir[2]	3,342	2,286	10	92	954
Ponderosa pine	13,212	8,293	201	1,675	3,043
Jeffrey pine	3,259	2,495	37	129	598
Sugar pine	6,926	5,184	47	545	1,150
Western white pine	298	233	--	10	55
Lodgepole pine	414	291	13	26	84
Knobcone pine	86	50	--	27	9
Brewer spruce	26	23	--	3	--
Mountain hemlock	122	117	--	3	2
Incense-cedar	2,161	1,012	4	355	790
Port-Orford-cedar	97	97	--	--	--
Western redcedar	50	50	--	--	--
Total	75,529	54,182	1,049	6,457	13,841
ardwoods:					
California black oak	520	199	16	69	236
Oregon white oak	58	14	2	3	39
Tanoak	157	152	--	--	5
Pacific madrone	195	155	1	17	22
Canyon live oak[3]	196	121	12	12	51
Other commercial hardwoods[4]	93	33	2	5	53
Total	1,219	674	33	106	406
ll species	76,748	54,856	1,082	6,563	14,247

---

[1] Includes small amount of grand fir.

[2] Includes California red fir and Shasta red fir.

[3] Includes golden chinquapin.

[4] Primarily white alder, Fremont cottonwood, quaking aspen, and bigleaf maple.

Table 21--*Net annual growth of growing stock and sawtimber on commercial forest land, by ownership class and by softwoods and hardwoods, California's Northern Interior, 1970*[1]

Ownership class	Growth per acre	All species	Softwoods	Hardwoods
	Cubic feet	*- - - - -Thousand cubic feet- - - - -*		
Growing stock:[2]				
National Forest	45	155,200	141,100	14,100
Other public	32	5,000	4,400	600
Forest industry	34	22,800	22,200	600
Farmer and miscellaneous private	37	63,100	58,700	4,400
All ownerships	41	246,100	226,400	19,700
	Board feet	*- - - - -Thousand board feet- - - - -*		
Sawtimber (International 1/4-inch rule):[3]				
National Forest	223	773,000	751,900	21,100
Other public	227	34,900	34,700	200
Forest industry	193	130,800	129,100	1,700
Farmer and miscellaneous private	184	316,100	308,600	7,500
All ownerships	208	1,254,800	1,224,300	30,500
Sawtimber (Scribner rule):[4]				
National Forest	185	644,400	623,800	20,600
Other public	181	27,900	27,700	200
Forest industry	146	99,400	97,700	1,700
Farmer and miscellaneous private	158	271,500	264,100	7,400
All ownerships	173	1,043,200	1,013,300	29,900

[1] See "Inventory Procedures," page 72, for actual period over which growth was measured.

[2] Includes trees 5.0-inch d.b.h. and larger.

[3] Includes softwood trees 9.0-inch d.b.h. and larger, and hardwood trees 11.0-inch d.b.h. and larger.

[4] Includes trees 11.0-inch d.b.h. and larger.

Table 22--*Net annual growth of growing stock on commercial forest land, by species and ownership class, California's Northern Interior, 1970*[1]

(In thousand cubic feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
oftwoods:					
Douglas-fir	68,700	46,300	2,400	4,500	15,500
White fir	65,000	40,500	500	8,900	15,100
Red fir[2]	8,000	7,200	100	-100[3]	800
Grand fir	(4)	(4)	--	--	--
Ponderosa pine	52,600	28,700	900	5,000	18,000
Jeffrey pine	11,700	7,800	300	900	2,700
Sugar pine	9,600	4,700	200	2,300	2,400
Western white pine	700	800	--	(4)	-100[3]
Lodgepole pine	2,200	1,300	(4)	300	600
Knobcone pine	100	(4)	--	--	100
Brewer spruce	(4)	(4)	--	(4)	--
Mountain hemlock	1,100	1,100	--	(4)	(4)
Incense-cedar	6,400	2,400	(4)	400	3,600
Port-Orford-cedar	200	200	--	--	--
Western redcedar	100	100	--	--	--
Total	226,400	141,100	4,400	22,200	58,700
ardwoods:					
California black oak	6,100	3,200	500	400	2,000
Oregon white oak	900	500	100	(4)	300
Tanoak	3,400	3,300	--	--	100
Pacific madrone	3,200	3,000	(4)	100	100
Canyon live oak[5]	3,400	3,100	(4)	100	200
Other commercial hardwoods[6]	2,700	1,000	(4)	(4)	1,700
Total	19,700	14,100	600	600	4,400
ll species	246,100	155,200	5,000	22,800	63,100

[1] See "Inventory Procedures," page 72, for actual period over which growth was measured.
[2] Includes California red fir and Shasta red fir.
[3] Negative growth results from annual mortality exceeding gross annual growth.
[4] Less than 50,000 cubic feet.
[5] Includes golden chinquapin.
[6] Primarily white alder, Fremont cottonwood, quaking aspen, and bigleaf maple.

Table 23--*Net annual growth of sawtimber on commercial forest land, by species and ownership class, California's Northern Interior, 1970 (International 1/4-inch rule)*[1]

(In thousand board feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	365,700	243,100	21,600	22,700	78,300
White fir[2]	379,700	229,700	3,000	58,600	88,400
Red fir[3]	49,900	39,600	600	600	9,100
Ponderosa pine	276,300	149,100	6,100	30,800	90,300
Jeffrey pine	53,600	33,800	2,100	4,700	13,000
Sugar pine	51,200	28,400	1,300	6,600	14,900
Western white pine	3,000	3,800	--	100	-900[4]
Lodgepole pine	8,400	6,800	-100[4]	1,200	500
Knobcone pine	200	200	--	--	--
Brewer spruce	400	300	--	100	--
Mountain hemlock	4,000	3,900	--	(5)	100
Incense-cedar	30,300	11,600	100	3,700	14,900
Port-Orford-cedar	1,100	1,100	--	--	--
Western redcedar	500	500	--	--	--
Total	1,224,300	751,900	34,700	129,100	308,600
Hardwoods:					
California black oak	10,200	4,600	(5)	1,200	4,400
Oregon white oak	800	300	(5)	(5)	500
Tanoak	5,000	5,000	--	--	(5)
Pacific madrone	7,500	7,200	(5)	100	200
Canyon live oak[6]	4,200	3,500	100	300	300
Other commercial hardwoods[7]	2,800	500	100	100	2,100
Total	30,500	21,100	200	1,700	7,500
All species	1,254,800	773,000	34,900	130,800	316,100

---

[1] See "Inventory Procedures," page 72, for actual period over which growth was measured.
[2] Includes small amount of grand fir.
[3] Includes California red fir and Shasta red fir.
[4] Negative growth results from annual mortality exceeding gross annual growth.
[5] Less than 50,000 board feet.
[6] Includes golden chinquapin.
[7] Primarily white alder, Fremont cottonwood, quaking aspen, and bigleaf maple.

able 24--*Net annual growth of sawtimber on commercial forest land, by species and ownership class, California's Northern Interior, 1970 (Scribner rule)*[1]

(In thousand board feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
ftwoods:					
Douglas-fir	319,200	211,100	17,800	18,500	71,800
White fir[2]	306,700	185,200	2,700	41,400	77,400
Red fir[3]	44,400	34,000	600	1,200	8,600
Ponderosa pine	213,100	118,300	3,500	22,200	69,100
Jeffrey pine	44,700	28,400	2,100	4,000	10,200
Sugar pine	45,900	23,700	1,100	7,900	13,200
Western white pine	2,500	3,100	--	100	-700[4]
Lodgepole pine	5,500	4,000	-100[4]	1,100	500
Knobcone pine	100	100	--	--	--
Brewer spruce	400	300	--	100	--
Mountain hemlock	3,100	3,000	--	(5)	100
Incense-cedar	26,100	11,000	(5)	1,200	13,900
Port-Orford-cedar	1,100	1,100	--	--	--
Western redcedar	500	500	--	--	--
Total	1,013,300	623,800	27,700	97,700	264,100
rdwoods:					
California black oak	10,101	4,600	(5)	1,200	4,300
Oregon white oak	800	300	(5)	(5)	500
Tanoak	5,000	5,000	--	--	(5)
Pacific madrone	7,300	7,000	(5)	100	200
Canyon live oak[6]	3,900	3,200	100	300	300
Other commercial hardwoods[7]	2,800	500	100	100	2,100
Total	29,900	20,600	200	1,700	7,400
ll species	1,043,200	644,400	27,900	99,400	271,500

---

[1] See "Inventory Procedures," page 72, for actual period over which growth was measured.
[2] Includes small amount of grand fir.
[3] Includes California red fir and Shasta red fir.
[4] Negative growth results from annual mortality exceeding gross annual growth.
[5] Less than 50,000 board feet.
[6] Includes golden chinquapin.
[7] Primarily white alder, Fremont cottonwood, quaking aspen, and bigleaf maple.

Table 25--*Average annual mortality of growing stock on commercial forest land, by species and ownership class, California's Northern Interior, 1970*[1]

(In thousand cubic feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	11,900	8,100	300	300	3,200
White fir	10,200	6,200	500	1,800	1,700
Red fir[2]	3,100	1,800	(3)	400	900
Ponderosa pine	6,300	2,400	100	1,000	2,800
Jeffrey pine	2,400	1,800	--	100	500
Sugar pine	4,800	4,000	--	100	700
Western white pine	400	100	--	--	300
Lodgepole pine	2,800	2,300	100	--	400
Knobcone pine	(3)	(3)	--	--	--
Mountain hemlock	200	200	--	--	--
Incense-cedar	2,000	800	--	500	700
Total	44,100	27,700	1,000	4,200	11,200
Hardwoods	800	600	100	(3)	100
All species	44,900	28,300	1,100	4,200	11,300

---

[1] See "Inventory Procedures," page 72, for actual period over which mortality was estimated.

[2] Includes California red fir and Shasta red fir.

[3] Less than 50,000 cubic feet.

Table 26--*Average annual mortality of growing stock on commercial forest land, by species and ownership class, California's Northern Interior, 1970 (International 1/4-inch rule)*[1]

(In thousand board feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	56,300	39,500	500	1,600	14,700
White fir	52,400	33,600	1,200	9,800	7,800
Red fir[2]	15,400	9,500	--	2,300	3,600
Ponderosa pine	30,000	11,400	300	4,300	14,000
Jeffrey pine	13,800	10,600	--	200	3,000
Sugar pine	29,300	25,000	--	600	3,700
Western white pine	2,000	600	--	--	1,400
Lodgepole pine	11,100	9,500	200	---	1,400
Knobcone pine	(3)	(3)	--	--	--
Mountain hemlock	600	600	--	--	--
Incense-cedar	9,500	3,600	--	2,200	3,700
Total	220,400	143,900	2,200	21,000	53,300
Hardwoods	1,500	1,300	200	--	--
All species	221,900	145,200	2,400	21,000	53,300

---

[1] See "Inventory Procedures," page 72, for actual period over which mortality was estimated.

[2] Includes California red fir and Shasta red fir.

[3] Less than 50,000 board feet.

Table 27--*Average annual mortality of growing stock on commercial forest land, by species and ownership class, California's Northern Interior, 1970 (Scribner rule)*[1]

(In thousand board feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	48,400	34,500	300	1,400	12,200
White fir	45,000	30,100	600	9,100	5,200
Red fir[2]	13,800	8,500	--	2,100	3,200
Ponderosa pine	25,700	9,800	400	3,900	11,600
Jeffrey pine	12,800	10,100	--	([3])	2,700
Sugar pine	27,300	23,600	--	600	3,100
Western white pine	1,600	400	--	--	1,200
Lodgepole pine	9,900	8,400	200	--	1,300
Knobcone pine	([3])	([3])	--	--	--
Mountain hemlock	400	400	--	--	--
Incense-cedar	7,900	2,800	--	2,000	3,100
Total	192,800	128,600	1,500	19,100	43,600
Hardwoods	1,500	1,300	200	--	--
All species	194,300	129,900	1,700	19,100	43,600

---

[1] See "Inventory Procedures," page 72, for actual period over which mortality was estimated.

[2] Includes California red fir and Shasta red fir.

[3] Less than 50,000 board feet.

Table 28--*Reported timber production by county in California's Northern Interior and all of California, 1946-73*[1]

(In thousand board feet)

ear	Lassen	Modoc	Siskiyou	Shasta	Trinity	All counties	California
946	294,530	177,890	172,030	232,510	73,040	950,000	3,001,780
947	200,696	148,634	203,687	218,046	119,123	890,186	3,185,995
948	360,959	209,920	291,746	257,399	132,850	1,252,874	3,983,213
949	339,598	172,087	236,798	217,007	101,011	1,066,501	3,795,252
950	229,952	222,636	266,240	221,332	105,115	1,045,275	4,303,011
951	313,604	191,437	284,348	373,888	144,917	1,308,194	4,984,288
952	167,224	155,082	330,142	296,864	214,271	1,163,583	5,057,036
953	196,168	86,172	380,073	486,669	319,398	1,468,480	5,990,088
954	241,752	70,040	425,187	347,483	252,061	1,336,523	5,600,310
955	256,759	46,670	377,728	418,544	296,893	1,396,594	6,014,939
956	169,185	73,512	469,317	412,056	266,406	1,390,476	5,861,634
957	150,346	31,543	439,564	432,829	351,217	1,405,499	5,346,521
958	54,261	40,711	389,440	537,573	347,985	1,369,970	5,675,392
959	144,567	50,880	379,698	441,717	439,222	1,456,084	5,886,061
960	98,182	42,296	315,325	552,685	305,842	1,314,330	5,136,649
961	121,131	59,555	337,175	455,289	377,191	1,350,341	5,342,250
962	126,662	60,301	410,145	568,926	369,601	1,535,635	5,538,928
963	78,907	54,672	605,642	442,171	369,541	1,550,933	5,461,046
964	134,313	48,463	494,411	530,721	317,742	1,525,650	5,476,265
965	129,557	54,624	490,584	503,896	265,070	1,443,731	5,271,234
966	110,974	91,762	465,472	421,560	220,058	1,309,826	5,008,318
967	74,171	78,948	581,198	441,213	243,282	1,418,812	5,062,021
968	88,559	85,171	582,723	459,238	255,647	1,471,338	5,343,898
969	91,220	75,956	516,692	411,089	248,348	1,343,305	5,000,596
970	81,384	99,371	469,350	401,951	214,637	1,266,693	4,565,827
971	135,850	80,325	480,084	402,329	199,811	1,298,399	4,789,617
972	97,800	98,803	463,624	405,883	244,332	1,310,442	5,000,507
973	119,671	95,883	462,213	401,546	235,035	1,314,348	4,923,000

---

[1] Source: "Production of California Timber Operators," State Forest Notes published annually
y California, Division of Forestry. Various log rules are used in California; no attempt was
ade to convert the data to a common base. However, the majority of the timber industry companies
n the Northern Interior used the short-log Scribner rule.

Table 29--*Sampling errors of estimate of forest area and timber volume, California's Northern Interior, January 1, 1970*

Item	Estimated total	Sampling error in percent	
		68-percent probability	95-percent probability
Commercial forest land	6,028,000 acres	± 1.1	± 2.1
Noncommercial forest land	3,043,000 acres[1]	± 2.8	± 5.5
Volume:			
Growing stock	15,901 million cubic feet	± 1.9	± 3.7
Sawtimber (International 1/4-inch rule)	86,013 million board feet	± 2.2	± 4.2

[1] The total area of unproductive forest land shown in table 4 is 3,211,000 acres, of which 3,043,000 acres were determined by sampling methods. The remaining 168,000 acres were estimated by type-mapping procedures and are not subject to sampling error.

Table 30--*Approximate sampling error by size of estimate, California's Northern Interior, January 1, 1970*

Commercial forest land		Growing stock		Sawtimber	
Area	Sampling error[1]	Volume	Sampling error[1]	Volume	Sampling error[1]
Thousand acres	*Percent*	*Million cubic feet*	*Percent*	*Million board feet*[2]	*Percent*
6,028	1.1	15,901	1.9	86,013	2.2
1,762	2.0	14,346	2.0	44,507	3.0
783	3.0	6,376	3.0	25,035	4.0
440	4.0	3,587	4.0	16,022	5.0
282	5.0	2,295	5.0	4,006	10.0
70	10.0	574	10.0	1,780	15.0
31	15.0	255	15.0	1,001	20.0
18	20.0	143	20.0	640	25.0
11	25.0	92	25.0	445	30.0
8	30.0	64	30.0	327	35.0
6	35.0	47	35.0	250	40.0
4	40.0	36	40.0		

[1] By random sampling formula; 68-percent probability.
[2] International 1/4-inch rule.

APPENDIX

Metric Conversions

1,000 acres = 404.69 hectares
1,000 cubic feet = 28.3 cubic meters
1 cubic foot per acre = 0.0700 cubic meter per hectare
1 square foot basal area per acre = 0.2296 square meter per hectare
1 foot = 30.48 centimeters
1 inch = 2.540 centimeters

Reliability of Forest Resource Estimates

Forest Land Area and Timber Volume

The estimates of forest land areas anc timber volume in Northern Interior California are derived by sampling and thus hav sampling errors. Sampling errors have beer computed for the estimates of commercia forest land area, noncommercial forest lan area, net cubic-foot volume of growing stock and net board-foot volume (Internationa 1/4-inch rule) of sawtimber. These samplin errors are presented in table 29 as a percent c the estimated total at the 68-percent and 95 percent probability levels. They may be interpreted as meaning that the odds are two out c three for 68-percent probability or 19 out of 2 for 95-percent probability and that the range shown include the true value (i.e., the resul of a 100-percent inventory). For example, w can expect, with 95-percent confidence, th the estimate of total commercial forest lar area—6,028,000 acres ± 2.1 percent (126,5 acres)—includes the true value.

In addition to measurable sampling error there may be other non sampling errors due mistakes in judgment, measurement, a compilation. The magnitude of errors of th nature cannot be determined. However, su errors are kept to a minimum through trainir supervision, field checking, and comple editing and machine verification in compili the data.

The sampling error of any breakdown these totals will be substantially greater th for the total. The smaller the breakdown, larger the sampling error. An approximation the increasing sampling error can be obtai from table 30, which shows the sampling er associated with smaller estimates.

Voody Plants of lorthern Interior orests

The list on page 70, compiled from Forest rvey field records, is presented to give the ader a general picture of the woody getation in the forests of the Northern erior, that is, the more common and teworthy trees, shrubs, and vines and some lication of where they grow. The list is by no eans complete, and exceptions in occurrence n be found; for example, western juniper pically occurs in the noncommercial wood- ıd zone east of the Cascade Range, casionally west of the Cascades, and also ar upper timberline. The zones used here e:

ne A.—Sacramento Valley, below the foothill chaparral and woodland zone. This zone is found only in extreme southern Shasta County. Forests in this zone are generally confined to stream banks, are of relatively little importance for industrial use, are important to wildlife, help prevent erosion, and are pleasant to look at.

ne B.—Foothills chaparral and noncommercial woodland zone (figs. 5, 6, 11, and 27), including forest fringe areas both east and west of the Cascade Range; generally corresponding to Merriam's Upper Sonoran Life Zone. Forests in this zone generally consist of trees or shrubs that have little industrial value but are important as wildlife habitat and watershed protection. In some areas the trees or shrubs have been removed to increase the grazing resources.

ne C.—Lower elevation commercial forest zone (figs. 28 and 29), immediately above zone B; generally corresponding to the lower end of Merriam's Transition Life Zone. Historically, this zone has produced a considerable volume of timber; but management for continuous timber crops is often difficult due to the hot, dry environment which discourages regeneration of commercial conifers.

Zone D.—Major commercial forest zone (figs. 2, 4, 7, 8, 9, 15, 16, 17, 19, 22, 23 and 34), immediately above zone C; generally corresponding to the upper end of Merriam's Transition Life Zone and the lower end of Merriam's Canadian Life Zone. This zone has produced the bulk of the industrial wood used in the past; much of this area is quite amenable to forest management due to the favorable tree-growing environment.

Zone E.—Upper commercial forest zone (figs. 1 and 2), immediately above zone D; generally corresponding to the upper part of Merriam's Canadian Life Zone. An increasing amount of timber is being cut from these high elevation forests as a result of the growing scarcity of timber in the main forest zone. Because of the short growing seasons, harsh winters, and prevalence of rugged terrain and rocky, shallow soils, this zone is less amenable to forest management than zone D and in some areas will produce little to no timber in the future.

Zone F.—Upper timberline zone (figs. 2, 12, 13, and 18), immediately above zone E; generally corresponding to the lower end of Merriam's Hudsonian Life Zone. Trees in this zone are usually stunted and deformed and often grow only in clumps and groves in protected locations. Though some timber has been cut in this zone, continuous timber production is generally impossible due to the severe climate and steep, rocky terrain.

Woody Plants of Northern Interior Forests [1/]

Scientific name	Common name	A Sacramento Valley	B Chaparral-woodland	C Lower commercial forest zone	D Main commercial forest zone	E Upper commercial forest zone	F Upper timber-line
Quercus lobata Neé.	California white oak	w					
Populus fremontii S. Wats.	Fremont cottonwood	m, w					
Crataegus douglasii Lindl.	Hawthorn	m, w&e					
Platanus racemosa Nutt.	California sycamore	m, w					
Prunus virginiana L. var. *demissa* (Nutt.) Sarg.	Choke cherry	m, w&e					
Vitis californica Benth.	California wild grape	m, w					
Clematis ligusticifolia Nutt.	Western clematis	m, w&e					
Cephalanthus occidentalis L. var. *californicus* Benth.	Buttonbush	m, w					
Fraxinus latifolia Benth.	Oregon ash	m, w					
Prunus subcordata Benth.	Western plum	m, w&e	m, w&e				
Rhus diversiloba Torr. & Gray	Poison oak	w	w	w			
Alnus rhombifolia Nutt.	White alder	m, w	m, w	m, w			
Populus trichocarpa Torr. & Gray	Black cottonwood	m, w&e	m, w&e	m, w&e	m, w&e		
Acer macrophyllum Pursh	Bigleaf maple	m, w	m, w	m, w	m, w		
Rubus ursinus Cham. & Schlecht.	Trailing blackberry	w&e	w&e	w&e	w&e	w&e	
Salix L. spp.	Willow	w&e	w&e	w&e	w&e	w&e	
Quercus douglasii H. & A.	Blue oak		w				
Quercus wislizenii A. DC.	Interior live oak		w				
Adenostoma fasciculatum H. & A.	Chamise		w				
Aesculus californica (Spach) Nutt.	California buckeye		w				
Quercus chrysolepis Liebm.	Canyon live oak		w	w			
Quercus garryana Dougl. var. *breweri* Jeps.	Oregon white oak		w	w			
Ceanothus lemmonii Parry	Lemmon ceanothus		w	w			
Ceanothus cuneatus (Hook.) Nutt.	Wedgeleaf ceanothus		w	w			
Cercis occidentalis Torr.	Western redbud		w	w			
Pinus sabiniana Dougl.	Digger pine		w	w			
Cercocarpus HBK. spp.	Mountain-mahogany		w&e	w&e			
Juniperus occidentalis Hook.	Western juniper		e	e			
Garrya fremontii Torr.	Silktassel		w	w			
Lonicera interrupta Benth.	Chaparral honeysuckle		w	w			
Lonicera hispidula Dougl.	Hairy honeysuckle		w	w			
Rhamnus californica Esch.	Coffeeberry		w	w			
Rhamnus crocea Nutt. var. *ilicifolia* (Kell.) C. B. Wolf	Hollyleaf coffeeberry		w	w			
Chrysothamnus Nutt. spp.	Rabbit brush		e	e			
Artemisia L. spp.	Sage		e	e			
Haplopappus Cass. spp.	Goldenbush		w&e	w&e			
Rhus trilobata Nutt.	Skunkbush		w&e	w&e			
Umbellularia californica (H. & A.) Nutt.	California laurel		w	w			
Monardella Benth. spp.	Monardella		w&e	w&e			
Cupressus bakeri Jeps.	Modoc cypress		r	r			
Cupressus macnabiana A. Murr.	MacNab cypress		r	r			
Ptelea crenulata Greene	Western hop tree		w	w			
Heteromeles arbutifolia M. Roem.	Toyon		w	w			
Eriodictyon californicum (H. & A.) Torr.	Yerba santa		w	w			
Arctostaphylos manzanita Parry	Manzanita		w	w			
Arctostaphylos viscida Parry	Whiteleaf manzanita		w	w			
Quercus kelloggii Newb.							

Quercus kelloggii Newb.	California black oak	w&e	w&e	w		
Pinus attenuata Lemm.	Knobcone pine	w	w	w		
Amelanchier Medic. spp.	Serviceberry	w&e	w&e	w&e		
Purshia tridentata (Pursh) DC.	Bitterbrush	e	e	e		
Ribes L. spp.	Gooseberry/currant	w&e	w&e	w&e	w&e	w&e
Populus tremuloides Michx.	Quaking aspen	m, e	m, e	m, e	m, e	m, e
Pinus ponderosa Laws.	Ponderosa pine		w&e	w&e		
Pseudotsuga menziesii (Mirb.) Franco	Douglas-fir		w&e	w&e		
Pinus lambertiana Dougl.	Sugar pine		w&e	w&e		
Corylus cornuta Marsh. var. *californica* (A.DC.) Sharp	Hazel		w&e	w&e		
Symphoricarpos Duhamel spp.	Snowberry		w&e	w&e		
Ceanothus integerrimus H. & A.	Deer brush		w	w		
Arctostaphylos patula Greene	Greenleaf manzanita		w&e	w&e		
Ceanothus prostratus Benth.	Squaw carpet		w&e	w&e		
Berberis L. spp.	Barberry		w&e	w&e		
Chamaecyparis lawsoniana (A. Murr.) Parl.	Port-Orford-cedar		w	w		
Lithocarpus densiflorus (H. & A.) Rehd.	Tanoak (tree)		w	w		
Prunus emarginata (Dougl.) Walp.	Bitter cherry		w&e	w&e		
Rubus leucodermis Dougl.	Raspberry		w&e	w&e	w&e	
Rubus parviflorus Nutt.	Thimbleberry		w&e	w&e	w&e	
Libocedrus decurrens Torr.	Incense-cedar		w&e	w&e	w&e	
Pinus jeffreyi Grev. & Balf.	Jeffrey pine		w&e	w&e	w&e	
Ceanothus velutinus Dougl.	Snowbrush			w&e		
Thuja plicata Donn	Western red cedar			m, w, r		
Abies concolor (Gord. & Glend.) Lindl.	White fir			w&e	w&e	
Ceanothus cordulatus Kell.	Mountain white thorn			w&e	w&e	
Lithocarpus densiflora (H. & A.) Rehd. var. *echinoides* (R.Br.) Abrams.	Shrub tanoak			w	w	
Pachistima myrsinites (Pursh) Raf.	Boxwood			w&e	w&e	
Acer circinatum Pursh	Vine maple			w	w	
Alnus tenuifolia Nutt.	Thinleaf alder			m, w&e	m, w&e	
Arctostaphylos nevadensis Gray	Pinemat manzanita			w&e	w&e	w&e
Castanopsis sempervirens (Kell.) Dudl.	Bush chinquapin			w&e	w&e	w&e
Acer glabrum Torr.	Mountain maple			w&e	w&e	w&e
Pinus contorta Dougl.	Lodgepole pine			w&e	w&e	w&e
Vaccinium L. spp.	Huckleberry				w&e	w&e
Quercus vaccinifolia Kell.	Huckleberry oak				w&e	w&e
Sorbus sitchensis Roem.	Mountain ash				w&e	w&e
Pinus monticola Dougl.	Western white pine				w&e	w&e
Picea breweriana Wats.	Brewer spruce				w, r	w, r
Abies magnifica A. Murr.	California red fir				w&e	w&e
Abies magnifica A. Murr. var. *shastensis* Lemm.	Shasta red fir				w&e	w&e
Tsuga mertensiana (Bong.) Carr.	Mountain hemlock				w&e	w&e
Alnus sinuata (Reg.) Rydb.	Sitka alder				m, w	m, w
Pinus albicaulis Engelm.	Whitebark pine					w&e, r
Pinus balfouriana Grev. & Balf.	Foxtail pine					w, r

Occurrence Codes:

- m - Generally restricted to moist sites.
- w - Generally found in the western parts of the Northern Interior, i.e., on the western slopes of the Cascades or in the Klamath and Coast Ranges or in the Sacramento Valley.
- e - Generally found in the eastern parts of the Northern Interior, i.e., east of the Cascades, or in Siskiyou County east of the Klamath Mountains.
- r - Rare, occurs in a few isolated spots.

Names of trees follow Little (1953); other plants follow Munz and Keck (1970).

Inventory Procedures

The summary tables in this report include data for National Forest lands collected by Regions 5 and 6 of the U.S. Forest Service and personnel from the various National Forests; and data for all other lands collected by Renewable Resources Evaluation personnel of the Pacific Northwest Forest and Range Experiment Station. The small parcel of land in Region 4's Toiyabe National Forest in the Northern Interior contains less than 500 acres of commercial forest and is not included in the summary tables. The same general definitions apply to all data, but slightly different data collection procedures were used by Regions 5 and 6 and Forest Survey.

Region 5 National Forests and lands outside National Forests were inventoried using a double sampling design. First, aerial photo sample plots 1 acre in size were distributed systematically across the area and classified into commercial forest, noncommercial forest, and nonforest. Commercial forest plots were further classified into several stand volume classes. Plots outside National Forests were also classified by kind of owner from public records. A random sample of field plots was selected, proportional to the number of aerial photo plots in each land class and volume class on National Forests, and in each land class, volume class, and ownership class on lands outside National Forests. Field plots consisted of 10 sample points distributed over an acre. The variable-radius plot sampling principle was used to select the trees to be tallied. Where no trees were tallied, a ground cover class was recorded. On lands outside National Forests in Lassen, Modoc, Shasta, and Trinity Counties, additional information was recorded, including soil depth by classes, indicator plants used to predict stockability and site index when suitable site trees were not present, and information on past disturbance or treatment. Growth estimates were obtained from measurements of past 10-year growth on increment borings of trees tallied on 3 of the 10 points of each plot. Outside National Forests, mortality was estimated by postdating dead trees over a 5-year period. The National Forests remeasured 2/5-acre plots that had been established several years before the current inventory to estimate mortality and also to reinforce the growth estimates from 10-point plots. On Region 5 National Forests, 27,829 aerial photo plots were examined. The field sample consisted of 2,001 plots, including 1,328 on commercial forest land, 464 on noncommercial forest land, and 209 on nonforest land. On lands outside National Forests, 16,056 aerial photo plots were examined. The field sample consisted of 1,228 plots, including 508 on commercial forest land, 312 on noncommercial forest land, and 408 on nonforest land.

The Rogue River National Forest (Region 6) was inventoried using a sample of plots located 1.7 miles apart in a grid pattern. The standard 10-point plot design was used, as described above, for all forest resource information except mortality which was estimated from remeasured 1/5-acre plots. The 25 plots examined included 23 on commercial forest land and 2 on nonforest land.

Fieldwork on commercial forest land was completed as follows:

	National Forests	**Year**
Region 5:	Klamath	1967
	Lassen	1970
	Mendocino	1971
	Modoc	1970
	Plumas	1969
	Shasta	1968
	Trinity	1969
	Six Rivers	1966
Region 6:	Rogue River	1967
	Outside National Forests	
	Lassen County	1971
	Modoc County	1971
	Siskiyou County	1968
	Shasta County	1970
	Trinity County	1970

No attempt was made to adjust the information from the various dates of collection to a common date. Such adjustment would result in very insignificant differences in the resource data from those published here. For all ownerships, the annual change in volume indicated by growth and cut is currently about 0.4 percent per year.

The information on both productive and unproductive forests in reserved areas, including National, State, and County Parks, and National Forest Wilderness and Natural Areas, was obtained by aerial photo sampling and type-mapping procedures and by collecting existing data from agency records. The estimate of total productive forest land area in reservations is probably high. Newer procedures used on nonreserved lands which showed previous estimates of commercial forest area to be too high were not used in reserved areas; and a subsample of ground plots was not established to adjust the aerial photo estimates. Spot checking in parts of the Salmon-Trinity Alps area revealed that many areas, though heavily timbered, were too steep and rocky to be managed. Almost without exception the reserved areas are in the higher elevations where soils are shallow, growing seasons are short, timber growth potential is low, and regeneration following disturbance is slow.

The timber cut information used in this report came from three sources: the State Forest Notes of the Office of the State Forester, "Production of California Timber Operators": the National Forest "Timber Cut and Sold" reports; and timber industry production reports prepared by the Pacific Southest and the Pacific Northwest Forest and Range Experiment Stations.

Definition of Terms

Land Area

Total land area is that reported by the Bureau of the Census and includes dry land and land temporarily or partially covered by water (such as marshes, swamps, and river flood plains), streams, sloughs, and canals less than 1/8 mile wide, and lakes, reservoirs, and ponds less than 40 acres in area.

Forest land is at least 10 percent stocked by trees of any size, or formerly having such tree cover, and not currently developed for nonforest use. Minimum area of forest land recognized is 1 acre.

Nonforest land has never supported forests or was formerly forested and is currently developed for nonforest uses. Included are areas used for agricultural crops, improved pasture, residential areas, city parks, improved roads of any width and their right-of-way clearings, powerline clearings of any width, and 1- to 40-acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and other nonforest strips must be more than 120 feet wide and clearings, etc., more than 1 acre in size, to qualify as nonforest land.

Forest Land Classes

Adverse location areas are productive forest land, often having merchantable stands of timber, but which, because of physical location, are impossible or difficult to harvest. This category of land was used only on National Forests.

Commercial forest land is capable of producing 20 cubic feet per acre per year of industrial wood and not withdrawn from timber utilization.

Critical watersheds are areas well within the forest zone and sites above the 20 cubic feet per acre per year productivity level; but because of unstable soil and other conditions, cannot be logged without seriously affecting the watershed. This category of land was used only on National Forests.

Noncommercial forest land includes both productive-reserved and unproductive forest land.

Productive-reserved forest land is withdrawn from timber utilization through statute, ordinance, or administrative order but otherwise qualifies as commercial forest land. In the Northern Interior all reserved forest land is in public ownership.

Unproductive forest land is incapable of yielding crops of industrial wood products because of adverse site conditions such as sterile soil, poor drainage, high elevation, steepness, and rockiness.

Forest Types

Forest types are determined on the basis of species plurality of all live trees that contribute to stocking, considering both size and spacing.

Tree Classes

Growing Stock

Sawtimber trees, poletimber trees, saplings, and seedlings are included; that is, all live trees except cull trees.

Sawtimber trees are 9.0-inch d.b.h. and larger (11.0-inch and larger for Scribner volume), live, and of commercial species. Softwood trees must contain at least one 12-foot saw log with a top diameter not less than 6 inches inside bark; hardwood trees must contain at least one 8-foot saw log with a top diameter not less than 8 inches inside bark. At least 25 percent of the board-foot volume in a tree must be free of defect for either softwoods or hardwoods.

Poletimber trees are 5.0- to 8.9-inch d.b.h., live, and of commercial species, not less than 25-percent sound on a cubic-foot basis, and with no disease, defects, or deformities which are likely to prevent their becoming growing-stock sawtimber trees.

Sapling and seedling trees are less than 5.0-inch d.b.h., live, of commercial species, and have no disease, defects, or deformities which are likely to prevent their becoming growing-stock poletimber trees.

Nongrowing Stock

Mortality trees are commercial species which have died from natural causes within a specified period and which were not cull trees at the time of death.

Salvable dead trees are standing or down, of commercial species, 11.0 inches or more in diameter, containing 25 percent or more of sound volume, and at least one merchantable 16-foot log if a softwood or one merchantable 8-foot log if a hardwood.

Stand Size Classes

Sawtimber stands are at least 10 percent stocked with growing-stock trees, with half or more of this stocking in sawtimber and poletimber trees and with sawtimber stocking equal to or greater than poletimber stocking. In *large sawtimber stands,* the majority of the sawtimber stocking is in trees 21.0 inches and larger at breast height. In *small sawtimber stands*, the majority of the sawtimber stocking is in softwood trees from 9.0- to 20.9-inch d.b.h. and hardwood trees 11.0- to 20.9-inch d.b.h.

Poletimber stands are at least 10 percent stocked with growing-stock trees, with half or more of this stocking in sawtimber and poletimber trees, and with poletimber stocking exceeding sawtimber stocking.

Sapling and seedling stands are at least 10 percent stocked with growing-stock trees, with more than half of this stocking in saplings, seedlings, or both.

Nonstocked areas of commercial forest land are less than 10 percent stocked with growing-stock trees.

Stocking

Stocking is an expression of the extent to which growing space is effectively utilized by present or potential growing-stock trees of commercial species. "Percent of stocking" is synonymous with "percentage of growing space occupied" and means the ratio of actual stocking to full stocking for comparable sites and stands. Basal area is used as a basis for measuring stocking.

Timber Volume

Live Sawtimber

Net volume of live sawtimber trees of commercial species is measured in board feet. Net volume equals gross volume less deduction of rot, sweep, crook, and other defects that affect use for lumber.

Scribner rule is the common board-foot log rule used locally in determining volume of sawtimber. Scribner volume was computed on a 16-foot-log basis to a California utilized top[14] for trees 11.0-inch d.b.h. and larger.

International 1/4-inch rule is the standard board-foot log rule adopted nationally by the Forest Service for the presentation of Forest Survey volume statistics. For calculating International 1/4-inch board-foot volume, the minimum diameter for softwood trees is 9.0-inch d.b.h. and the minimum log length is 12 feet with a small end diameter of 7.0 inches outside bark. The minimum diameter for hardwoods is 11.0 inches breast high, with a minimum log length of 8 feet and a small diameter of 9.0 inches outside bark.

Growing Stock

Net volume in cubic feet of live sawtimber trees and live poletimber trees from stump to a minimum 4.0-inch top (of central stem) outside bark is measured. Net volume equals gross volume less deduction for rot and missing bole sections.

Industrial Wood

All roundwood products, except fuelwood, are included.

Net Annual Growth

The net increase in volume of trees during a specified year is included. (Components of net annual growth include: (a) the increment in net volume of trees at the beginning of the specified year surviving to the year's end, plus (b) the net volume of trees reaching the size class during the year, minus (c) the net volume of trees that died during the year, minus (d) the net volume of trees that become culls during the year.)

Ownership Classes

National Forest lands are Federal lands which have been designated by Executive Order or statute as National Forests or purchase units and other lands under the administration of the Forest Service, including experimental areas and Bankhead-Jones title III lands.

Other public lands are Federal lands other than National Forests, including lands administered by the Bureau of Land Management, Bureau of Indian Affairs, and miscellaneous Federal agencies, and lands owned by States, counties, and local public agencies, or lands leased by these governmental units for more than 50 years.

Forest industry lands are owned by companies or individuals operating wood-using plants.

Farmer-owned lands are lands owned by operators of farms.

Miscellaneous private—corporate lands are owned by companies or corporations that do not operate wood-using plants. Included are corporate farms, some railroad lands, oil company lands, real estate and land-holding company lands, and lands held by banks, other financial institutions, and various other companies and corporations.

Miscellaneous private—noncorporate lands are privately owned lands other than forest industry, farmer-owned, or corporate lands.

---

[14] Utilization study data are on file at the Pacific Southwest Forest and Range Experiment Station, Berkeley, California.

☆GPO—697-094

Bolsinger, Charles L.
1976. Timber resources of Northern Interior California, 1970.
USDA For. Serv. Resour. Bull. PNW-65, 75 p., illus.

This report summarizes a timber resource inventory in Lassen, Modoc, Siskiyou, Shasta, and Trinity Counties, California. Included are detailed tables of forest area, timber volume, growth, mortality, and removals and a discussion of the current timber resource and timber industry situation.

Keywords: Forest surveys (North Central California), resources (forest), statistics (forest).

Bolsinger, Charles L.
1976. Timber resources of Northern Interior California, 1970.
USDA For. Serv. Resour. Bull. PNW-65, 75 p., illus.

This report summarizes a timber resource inventory in Lassen, Modoc, Siskiyou, Shasta, and Trinity Counties, California. Included are detailed tables of forest area, timber volume, growth, mortality, and removals and a discussion of the current timber resource and timber industry situation.

Keywords: Forest surveys (North Central California), resources (forest), statistics (forest).

Bolsinger, Charles L.
1976. Timber resources of Northern Interior California, 1970.
USDA For. Serv. Resour. Bull. PNW-65, 75 p., illus.

This report summarizes a timber resource inventory in Lassen, Modoc, Siskiyou, Shasta, and Trinity Counties, California. Included are detailed tables of forest area, timber volume, growth, mortality, and removals and a discussion of the current timber resource and timber industry situation.

Keywords: Forest surveys (North Central California), resources (forest), statistics (forest).

Bolsinger, Charles L.
1976. Timber resources of Northern Interior California, 1970.
USDA For. Serv. Resour. Bull. PNW-65, 75 p., illus.

This report summarizes a timber resource inventory in Lassen, Modoc, Siskiyou, Shasta, and Trinity Counties, California. Included are detailed tables of forest area, timber volume, growth, mortality, and removals and a discussion of the current timber resource and timber industry situation.

Keywords: Forest surveys (North Central California), resources (forest), statistics (forest).

The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Developing and evaluating alternative methods and levels of resource management.
3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research are made available promptly. Project headquarters are at:

Fairbanks, Alaska
Juneau, Alaska
Bend, Oregon
Corvallis, Oregon
La Grande, Oregon
Portland, Oregon
Olympia, Washington
Seattle, Washington
Wenatchee, Washington

Mailing address: Pacific Northwest Forest and Range
Experiment Station
P.O. Box 3141
Portland, Oregon 97208

The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

The U.S. Department of Agriculture is an Equal Opportunity Employer. Applicants for all Department programs will be given equal consideration without regard to race, color, sex or national origin.

3.80:PNW66

USDA FOREST SERVICE RESOURCE BULLETIN PNW-66

197

imber Resources of
ouglas County, Oregon

Colin D. MacLean

OREGON UNIVERSITY LIBRARY
NOV 28 1977
& ACQ. DIV.

NORTHWEST FOREST AND RANGE EXPERIMENT STATION / U. S. DEPARTMENT OF AGRICULTURE / PORTLAND, OREG

Forest Resources Evaluation Work Unit

Charles Van Sickle, *Project Leader*
Donald R. Gedney, *Principal Resource Analyst*
John M. Berger, *Compilation Supervisor*
Dale R. Baer, *Field Supervisor*

Field and Office Work for Douglas County

Field Supervisor

Charles L. Bolsinger

Survey Design

Colin D. MacLean

Data Collection

Steven Bush
Chris Carter
Perry Colclasure
Terry Graham
Bruce Hiserote
Mike House
Warren Sasaki
Brian Wood

Office Staff

Grace Begay
Linda Brown
Ardella DeVan
Fay Page
Kathleen Wutzke

Assistant Field Supervisors

Dale R. Baer
Hal A. Arbogast
J. D. Lloyd, Jr.

Data Compilation

Paulma Allord
Patricia M. Bassett
Ed Holt
David Jacobs
Mary Anne Mei
Marian Simons
Susan Weaver

Acknowledgment is made of the cooperation and assistance of many public agencies and private timber companies.

The U.S. Forest Service supplied forest resource data for National Forests. The Bureau of Land Management, U.S. Department of the Interior, supplied resource data for Bureau of Land Management lands.

The county assessor and several private timber companies furnished ownership information. The Douglas County Forest Protective Association, U.S. Forest Service, Bureau of Land Management, and several private timber companies provided maps and information on access to forest lands as well as general information related to forest management practices in Douglas County.

TIMBER RESOURCES OF DOUGLAS COUNTY, OREGON

Reference Abstract

MacLean, Colin D.
1976. Timber resources of Douglas County, Oregon. USDA For. Serv. Resour. Bull. PNW-66, 42 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report summarizes a 1973 timber resource inventory of Douglas County, Oregon. Detailed tables of forest area, timber volume, growth, mortality, and cut are presented. A discussion of the present resource situation highlights the condition of cutover lands and the opportunities for silvicultural treatment.

KEYWORDS: Forest surveys, statistics (forest), resources (timber), southwest Oregon, Douglas County.

RESEARCH SUMMARY

Resource Bulletin PNW-66

1976

Douglas County has 66 billion board feet of sawtimber--75 percent of it Federally owned and 21 percent owned by forest industry. Sixty percent of the private commercial forest land has been clearcut and an additional 20 percent partially cut. At the current rate of harvest, the private sawtimber inventory will not last 20 years.

Poor conifer stocking prevails on over half of the county's clearcut area. About one-third of the Federal clearcut area, over half of the forest industry clearcuts, and over two-thirds of the other private clearcut lands are inadequately stocked with conifers. Many of the poorly stocked acres are on "tough sites" where planting is both expensive and uncertain of success.

About half the commercial forest area in the county is suitable for final or intermediate harvest. Another 20 percent is either nonstocked or partially stocked with conifers and needs planting or stand conversion. Many of the poorly stocked acres are now covered with brush or hardwoods. Four percent of the commercial forest land--all in nonindustrial private ownership--is brushy, nonstocked cutover on low site where treatment is not feasible because of high cost, low return, and the likelihood of failure.

Immature stands of conifer stock 22 percent of the county's commercial forest land. However, over half these stands would grow faster if excess competition were removed, either through cleaning of brush and hardwoods or through precommercial thinning.

Preface

This report summarizes some of the findings of the fourth inventory of the timber resources of Douglas County, Oregon. It has two parts. The first describes the current resource--the area of commercial forest land and the timber volume on that land by species, owner, and tree size. The second part describes the condition of the forest land as a base for growing future crops of timber. The changes in resources since the previous (1962) inventory are not examined in this report.

Field data for all lands except National Forests and lands administered by the Bureau of Land Management were collected by the Forest Resources Evaluation Work Unit of the Pacific Northwest Forest and Range Experiment Station. Resources Evaluation (formerly Forest Survey) is a nationwide project of the Forest Service authorized by the McSweeney-McNary Forest Research Act of 1928 and amended by the Forest and Rangeland Renewable Resources Planning Act of 1974. The purposes of Forest Resources Evaluation are (1) to obtain comprehensive information on timber and other forest resources, including the extent and condition of forest lands, the amount and kind of timber growing on these lands, the rate of forest growth and depletion, the amount of timber cut, and probable future trends in timber requirements; and (2) to analyze and make available resource information needed to formulate forest policies and programs. Resurveys are made periodically to update basic information.

Resources evaluations are conducted throughout the 50 States by the U.S. Forest Service Experiment Stations. The Pacific Northwest Forest and Range Experiment Station at Portland, Oregon, is responsible for resources evaluation in the States of Alaska, California, Hawaii, Oregon, and Washington.

The basic inventory data for lands administered by the Bureau of Land Management (BLM) were collected by that agency in 1966 on the Medford District and 1968-69 on other BLM lands. Current (1973) data were furnished by the agency on all field plots silviculturally treated or cutover since inventory, including the status of all plantations. National Forest inventory data were collected by personnel at each National Forest. Dates of the basic inventories were 1963 on the Siuslaw National Forest, 1967 on the Rogue River National Forest, 1968 on the Umpqua National Forest, and 1970 on the Willamette National Forest. All except the Willamette were updated to 1973 in the same manner as the BLM inventories. Field data for other ownerships were collected by Forest Resources Evaluation personnel during the summer of 1973.

Contents

Page

INTRODUCTION 1

THE CURRENT TIMBER SITUATION 1
  The Total Inventory 1
  Who Owns the Timber? 2
  The National Forests 2
  Bureau of Land Management Lands 4
  Forest Industry Lands 6
  Other Private Lands 7
  Other Public Lands 9
  Growth and Mortality 9

OPPORTUNITIES FOR SILVICULTURAL TREATMENT 10
  The National Forest and BLM Lands 11
  Forest Industry Lands 12
  Other Private Lands 14
  Other Public Lands 15

CONCLUSION 15

TABLES FOR DOUGLAS COUNTY, OREGON, JANUARY 1, 1974 16

STOCKING 33

PLANT SPECIES 35

INVENTORY PROCEDURES 37
  National Forest and BLM Inventories 37
  The Inventory of Private and Other Public Lands 38

DEFINITION OF TERMS 38

LITERATURE CITED 42

Tables for Douglas County, Oregon, January 1, 1974

Page

1. Area by land class 16
2. Area of commercial forest land by ownership class 17
3. Area of commercial forest land by cubic-foot site and ownership classes 17
4. Area of commercial forest land on conifer sites by ownership, conifer stocking, and stand-size classes 18
5. Area of commercial forest land by forest type and ownership class . . 19
6. Volume of growing stock and sawtimber on commercial forest land by ownership class and by softwood and hardwoods 20
7. Net volume of growing stock on commercial forest land by species and ownership class 21
8. Net volume of growing stock on commercial forest land by species and ownership class (International 1/4-inch rule) 22
9. Net volume of growing stock on commercial forest land by species and ownership class (Scribner rule) 23
10. Volume of timber on commercial forest land by class of timber and by softwoods and hardwoods 24
11. Net annual growth of growing stock and sawtimber on commercial forest land by ownership class and by softwood and hardwoods 25
12. Net annual growth of growing stock on commercial forest land by species and ownership class 26
13. Net annual growth of sawtimber on commercial forest land by species and ownership class (International 1/4-inch rule) 27
14. Average annual mortality of growing stock and sawtimber on commercial forest land by ownership class and by softwoods and hardwoods 28
15. Average annual mortality of growing stock on commercial forest land by species and ownership class 29
16. Average annual mortality of sawtimber on commercial forest land by species and ownership class (International 1/4-inch rule) 30
17. Timber harvest by ownership class, Douglas County, Oregon, 1950-73 (International 1/4-inch rule) 31
18. Area by treatment and ownership class 31

Introduction

Douglas County, with a gross area of over 3 million acres, is the largest county in western Oregon and the fourth largest in the State. Except for a belt of agricultural land and oak woodland paralleling the Umpqua River in the central interior, the county is predominantly coniferous forest. With 2.6 million acres of commercial forest land, it has more area devoted to timber production than any other county in the State. Douglas County land supports a high timber volume and, together with neighboring Lane County, leads the State in both timber inventory and log production.

As recently as 1933 (USDA Forest Service 1934), three-quarters of the county's commercial forest land was dominated by large conifer sawtimber trees. Since then, some 50 billion board feet[1/] of timber have been removed (Wall 1972), supporting a timber industry that dominates the economy of the county. Although 42 years of cutting have substantially reduced the volume of standing timber, the remaining board-foot inventory still exceeds that of 44 of the 50 States (USDA Forest Service 1973).

Directly or indirectly, the economy of Douglas County depends almost entirely on timber (Darr and Fight 1974). As the stockpile of old-growth timber declines, local and regional planners are asking increasingly urgent questions. They still need to know how much of the old-growth timber remains; but they are also vitally interested in the condition of the rest of the resource--the cutover lands from which future timber supplies must come. This new inventory provides essential data for answering both kinds of questions.

The Current Timber Situation

THE TOTAL INVENTORY

Douglas County is over 80-percent commercial forest land with a sawtimber inventory volume of 65.9 billion board feet. Small amounts of the productive forest land have been reserved from cutting by statute or administrative order--a portion of the Oregon Dunes National Recreation Area and several small public parks. Approximately 5 percent of the county is unproductive forest land: two-thirds oak woodlands and one-third rough land, too steep and rocky for timber production on a continuous basis. Less than 14 percent of the county is nonforest land.

Area in each land class in Douglas County is shown below:

Land class	Area (Thousand acres)
Commercial forest	2,641
Productive reserved forest	7
Unproductive forest	150
Nonforest	442
All classes	3,240

[1/] Board-foot volumes in this report are according to the International 1/4-inch rule.

WHO OWNS THE TIMBER?

The U.S. Government is the single largest timber owner in Douglas County with 57 percent of the commercial forest land (fig. 1) and 75 percent of the sawtimber volume (fig. 2). An additional 2 percent of both land and volume is held by the State, the county, and several municipalities. Forest industries hold 29 percent of the commercial forest land and 21 percent of the volume. The remaining 12 percent of the commercial forest land is owned by other private owners. These lands have been almost entirely cutover and have negligible timber volume.

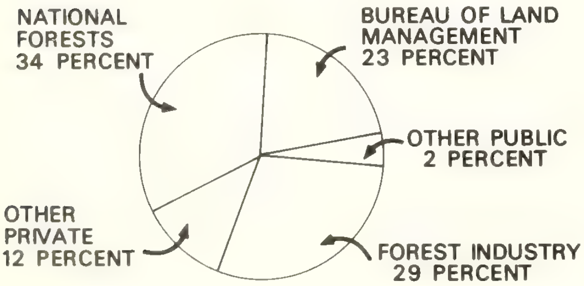


Figure 1.--Distribution of commercial forest land area by owner, January 1, 1974.

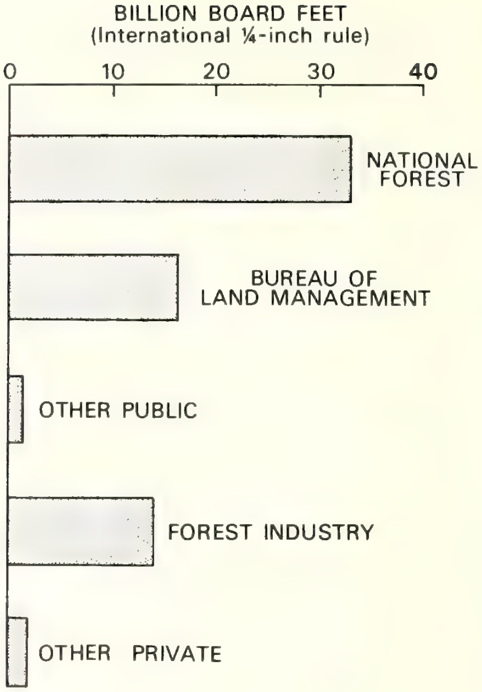


Figure 2.--Volume of sawtimber on commercial forest land by owner, January 1, 1974.

THE NATIONAL FORESTS

Most of the Umpqua National Forest and parts of three other forests--the Siuslaw, the Rogue River, and the Willamette--fall within the boundaries of Douglas County. With 34 percent of the commercial forest land in the county, the National Forests represent the largest single forest land owner. Of that land 70 percent is occupied by timber stands that are over 100 years old, making the National Forests the largest remaining reserve of old-growth timber in the county. The sawtimber inventory of over 32 billion board feet (fig. 2) represents half the volume in the county.

Douglas-fir type predominates (fig. 3), but over one-fifth of the commercial forest land is in true fir-mountain hemlock and lodgepole pine types. These types occur at higher elevations where growth rates are characteristically slow, particularly during the early life of the stand, and where regeneration problems are often encountered. Such areas are valuable for recreation, watershed protection, and scenery. Although currently supporting a large sawtimber inventory accumulated over several hundred years, these lands are likely to contribute less to future timber supply than more productive but less scenic lands at lower elevations.

Figure 3.--Mature stands of Douglas-fir like this predominate on Federal lands.

Before World War II, little logging took place on National Forest land in Douglas County. Since that time, about 109,000 acres have been clearcut and another 43,000 acres have been partially cut (fig. 4). Eighty-three percent of the commercial forest land on National Forests is still uncut and all but 75,000 acres are stocked with sawtimber stands--90 percent of them over 100 years old.

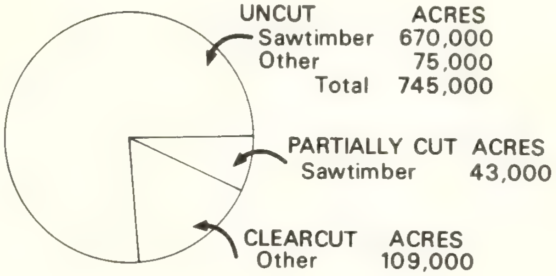


Figure 4.--Commercial forest land on National Forests by cutting history and stand-size class, January 1, 1974.

Not all the National Forest sawtimber is equally available for harvest. Only 58 percent[2] of the commercial forest area is considered part of the "standard component" (defined in the Forest Service Manual as "...regulated commercial forest land area on which crops of industrial wood can be grown and harvested with adequate protection of the forest resource under the usual provisions of the timber sale contract."). An additional 26 percent--the "special component"--falls in travel and water influence zones and on the peripheral portions of developed sites where various harvesting restrictions reduce yields, raise logging costs, or both. The remaining 16 percent--the "marginal component"--includes timber that is unlikely to be sold within the next 10 years because of high development costs, low product values, or resource protection constraints. The commercial forest area on National Forest land is distributed among the components as follows:

---

[2] Data as of January 1, 1974. Component classification is subject to periodic revision.

Component	Area (Thousand acres)
Standard	515
Special	236
Marginal	146
Total commercial forest	897

Almost 4 percent of the clearcut acres are recent clearcuts scheduled for planting. Another 59 percent have been satisfactorily restocked (stocking definitions on page 32). Conifer stocking on an additional 23 percent of the clearcut acres is insufficient for full utilization of the site. The remaining 14 percent are nonstocked (fig. 5). Three-quarters of the unsatisfactorily stocked clearcuts are on harsh sites with shallow soil (called "tough sites" in this report). These areas have proved difficult to regenerate and plantation failures are common, especially in the South Umpqua River drainage, where the soil and climate are particularly inhospitable to young seedlings. Currently, large clearcuts are avoided on these tough sites. Instead, a shelterwood overstory is left to provide shade until the young seedlings are established. Forest silviculturists hope this practice will permit better regeneration success in the future.

Today, National Forest lands in Douglas County are still dominated by mature stands of conifer; but eventually, the old growth will be gone and the harvest will come from regenerated stands. Then, stands that were inadequately restocked will produce low yields.

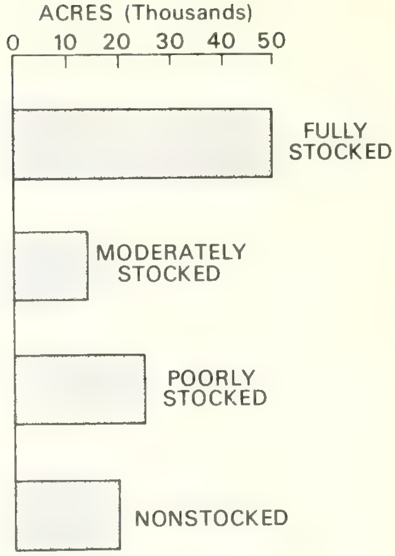


Figure 5.--Acres clearcut on National Forest land by stocking class, January 1, 1974. "Nonstocked" includes recent clearcuts.

Although 41 percent of the clearcut areas are not satisfactorily stocked, the acreage involved is fairly small. However, many uncut stands pose the same regeneration hazards that have proved so vexing in the past. Unless tough site regeneration problems are solved, large areas of poorly stocked cutover may be created, proportionately lowering future timber yields.

BUREAU OF LAND MANAGEMENT LANDS

The Bureau of Land Management (BLM) administers 609,000 acres of commercial forest land within Douglas County. Four Districts are represented--Roseburg, Medford, Coos Bay, and Eugene. In total, the BLM land includes 23 percent of the commercial forest land and 25 percent of the sawtimber volume in the county.

Generally, the BLM lands lie at lower elevations and are closer to settled areas than the National Forests. Thus, they show greater evidence of both fire and cutting activities than the National Forest lands, with regeneration and immature sawtimber stands more common. Still, 45 percent of the BLM's commercial forest is sawtimber over 100 years old--37 percent uncut sawtimber and 8 percent partially cut sawtimber. In addition, there are 104,000 acres of younger sawtimber--27,000 of them partially cut. In total, 62 percent of the commercial forest area supports sawtimber stands (fig. 6).

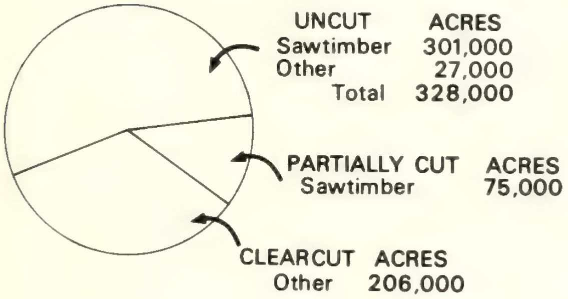


Figure 6.--Commercial forest land administered by the Bureau of Land Management by cutting history and stand-size class, January 1, 1974.

With an inventory of over 17 billion board feet, the BLM has the second largest volume of sawtimber in the county. BLM land is typically lower elevation Douglas-fir type, checkerboarded with private cutover (see cover). Fragile higher elevation sites are uncommon, and recreation pressure is relatively light compared with the National Forests. As a result, land use restrictions on timber harvest are few. Most of the BLM area is comparable to the "standard component" on National Forests.

Although the BLM sawtimber inventory is only one-half that of the National Forests, the annual harvest on the two ownerships is nearly equal. This difference occurs, at least partly, because BLM lands are inherently more productive than National Forest lands and are subject to fewer restraints on timber harvest. The net effect is that the stocks of mature timber on BLM lands are being harvested at a faster rate than on National Forest lands. Even so, complete conversion to second-growth management is at least 40 or 50 years away. In the meantime, the timber harvest will come from stands now classed as sawtimber.

One-third of the commercial forest land administered by BLM has been clearcut. Sixty-eight percent of the clearcut acres have satisfactorily restocked, 21 percent are poorly stocked, and the remaining 11 percent are nonstocked (fig. 7). More than half the nonstocked area has been cutover in the last 5 years and is scheduled for planting.

BLM clearcuts have been regenerated more successfully than those of any other ownership. Still, one-fourth of the area that was clearcut more than 5 years ago is unsatisfactorily stocked. As on National Forests, tough site regeneration problems must be solved if production goals are to be met.

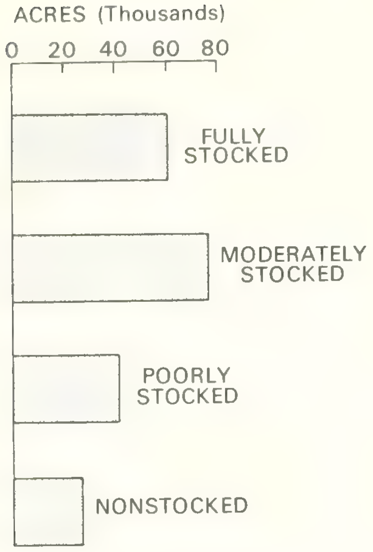


Figure 7.--Acres clearcut on Bureau of Land Management land by stocking class, January 1, 1974. "Nonstocked" includes recent clearcuts.

FOREST INDUSTRY LANDS

Forest industry owns 773,000 acres of commercial forest land in Douglas County. Although logging history on these lands dates back to the turn of the century, most areas were untouched until the 1940's. Then, after World War II, log harvest was greatly accelerated. During the late 1940's and early 1950's, 80 to 90 percent of the total log harvest was from private lands--predominantly forest industry. Since that time, cut has dropped on private lands and increased on public lands until, by the early 1970's, the forest industry share of the total log harvest was about 40 percent. Not surprisingly, the saw-log inventory on forest industry lands has been substantially reduced as a result of this cutting.

Forest industry owns 21 percent of the sawtimber volume on 29 percent of the commercial forest acres in the county. Forty-three percent of the commercial forest area still supports sawtimber stands, but half has been partially cut (fig. 8). Most of the sawtimber is over 100 years old; however, a third is younger. Some of the younger stands were regenerated after clearcutting in the early part of the century.

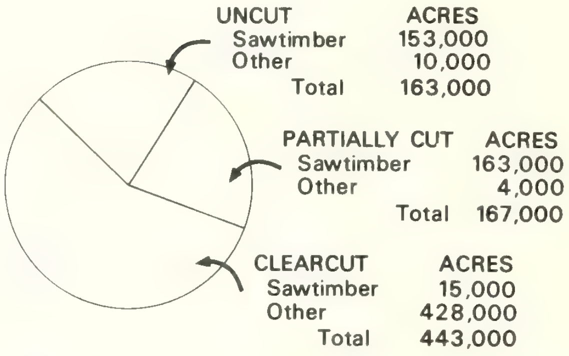


Figure 8.--Commercial forest land owned by forest industry by cutting history and stand-size class, January 1, 1974.

Forest industry land supports a sawtimber inventory of almost 14 billion board feet. At the current rate of harvest, the inventory will not last more than 20 years. Although this supply will be supplemented by stands which grow to sawtimber size, such stands are limited. Forest industry owns only 52,000 acres of poletimber lands; over half of these are understocked. These data appear to confirm the conclusion reached by Beuter et al. (1976) that the timber harvest from industrial lands in Douglas County will be greatly reduced by the year 2000.

What will be the timber harvest from forest industry lands during the early decades of the next century? The answer will depend on how well the cutover is regenerated and on the intensity of timber management. Future yields may be enhanced by good silviculture provided the growing stock is there to manage. Poorly stocked forest lands will produce low yields, regardless of management efforts.

Because of low conifer stocking, 62 percent of the forest industry clearcut area is underutilized (fig. 9)--24 percent nonstocked and 38 percent poorly stocked.

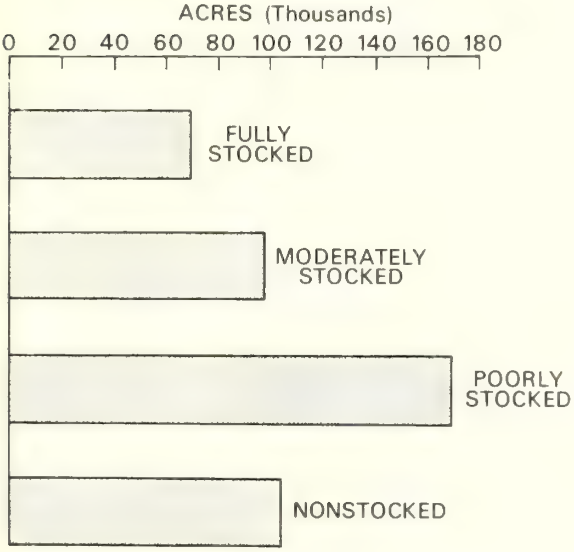


Figure 9.--Acres clearcut on forest industry land by stocking class, January 1, 1974. "Nonstocked" includes recent clearcuts.

Stocking class distribution on forest industry land by date of cutting is:

Date of clearcutting	Satisfactorily stocked
	(Percent)
1968-70	54
1963-67	41
1953-62	53
Before 1953	48

Regeneration problems obviously still exist on forest industry lands as well as on other ownerships. Data for the years 1971-73 were not included in this analysis because many of the recent clearcuts had not yet been planted.

Accelerated management efforts may alter this picture. Nevertheless, any projection of future yields from regenerated stands on industrial lands must take into account the impact of sparse conifer stocking.

OTHER PRIVATE LANDS

Farmers own 235,000 acres of commercial forest land in Douglas County; an additional 71,000 acres are owned by other miscellaneous private owners. These lands are concentrated at lower elevations on hot, dry sites (fig. 10). In general, they tend to be less productive and more subject to regeneration failure than other forest lands in the county. Heavy logging during the years immediately after World War II removed most of the original sawtimber (fig. 11). Only 1.6 billion board feet remain--an average of only 5,216 board feet per acre.

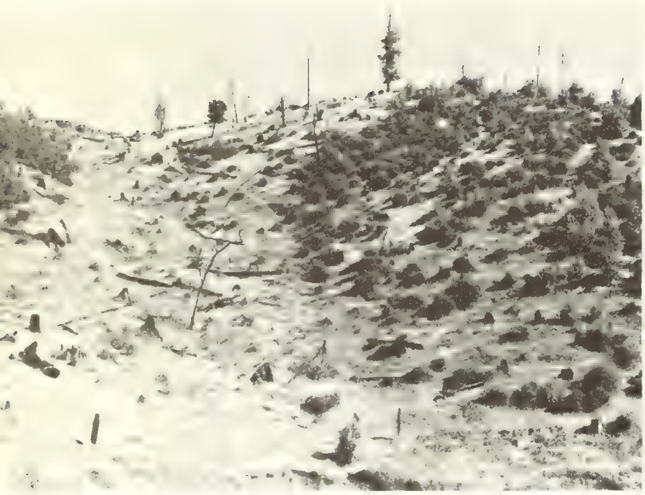


Figure 10.--Many of the other private lands occur at lower elevations, and the hot dry sites are difficult to regenerate.

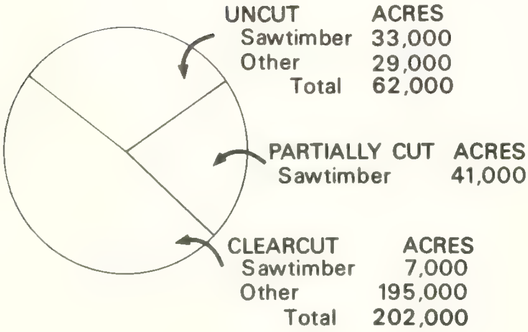


Figure 11.--Commercial forest land owned by other private owners by cutting history and stand-size class, January 1, 1974.

Stocking is typically poor on the cutover lands of other private owners (fig. 12). Only one-fourth of the clearcut area is satisfactorily stocked and 65 percent nonstocked. Seventy percent of the nonstocked land was logged more than 20 years ago; an additional 23 percent was logged more than 15 years ago. This land is now dominated by a heavy hardwood and brush cover. Reforestation is generally difficult and expensive.

The current inventory is low on other private lands in Douglas County. In addition, there is little immature growing stock to provide future harvests. Other private lands are unlikely to contribute materially to the Douglas County timber supply in the foreseeable future.

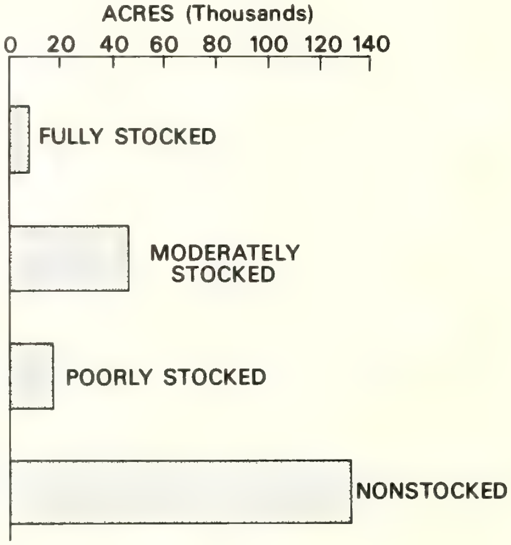


Figure 12.--Acres clearcut on other private commercial forest lands by stocking class, January 1, 1974. "Nonstocked" includes recent clearcuts.

OTHER PUBLIC LANDS

State, county, and municipal governments own only 56,000 acres of commercial forest land in Douglas County. The total sawtimber volume on these lands is about 1 billion board feet. The inventory sample on these lands was too small to permit a meaningful breakdown of the area into condition classes. Based on our limited sample, they appear to resemble forest industry lands more than any other owner group.

GROWTH AND MORTALITY

The following tabulation compares rates of conifer growth found on the five major forest owner groups:

Owner	Annual gross growth/acre	Annual mortality/acre	Net annual growth/acre
		(Cubic feet)	
National Forests	60	22	38
Bureau of Land Management	58	31	27
Other public	59	14	45
Forest industry	38	15	23
Other private	37	1	36

Growth rates are low in Douglas County relative to their potential. The reason varies between owner groups. Growth rates reflect the basic productivity of the land; but more important, they also reflect the stage of development and the stocking level of the stands.

Public lands are predominantly well stocked with mature timber. For these trees, the period of rapid growth has already passed. Even so, they are growing at a rate comparable to that for normal 150-year-old stands growing on site III (McArdle et al. 1961). Gross growth still exceeds mortality by about 40 cubic feet per acre per year.

Forest industry land also supports some mature timber stands growing at a rate comparable to the public forests. However, half of the industry land is either occupied by seedling and sapling stands or nonstocked. Since volume growth is measured only on trees 5 inches and larger in diameter, no growth is measured on these stands. Stands in the highly productive 30- to 60-year age range are rare on forest industry lands. The net result is a growth rate considerably lower than that found on public lands.

Other private lands do support some stands which are at the age where growth rates range from 100 to 200 cubic feet per acre per year. However, 2 out of every 3 acres are poorly stocked or nonstocked. As long as this condition prevails, growth rates will remain far below the potential for the ownership.

Given the present imbalance of age classes, growth rates are not really a useful tool for assessing the status of timber management in Douglas County. A more effective approach is to assess the condition of the land and to determine what silvicultural practices would be required to bring the land into full production. The next section of this report will consider these questions.

Opportunities for Silvicultural Treatment

Timber volume inventories are usually used to estimate shortrun timber supply, and stocking surveys typically describe the condition of the cutover lands--the source of supply in the more distant future. Additional information is needed to learn how thinning, planting, and control of competing vegetation can contribute to increased wood production. By analyzing supplemental data collected as part of the Douglas County inventory, we have identified the silvicultural activities needed to bring the land up to full timber production. Although fertilization is not specifically identified as a treatment in the discussion that follows, it will probably increase yields of adequately stocked stands, particularly when combined with other treatments (Miller and Williamson 1974). Likewise, when planting is prescribed, high quality stock can be expected to increase future yields.

Specific treatments identified in the inventory include:

Regeneration cutting.--Stands past the age of culmination of mean annual cubic-foot increment are regeneration cutting opportunities.

Commercial thinning.--Stands younger than the age of culmination with more conifer stocking than is needed to exploit the growth potential of the site are candidates for commercial thinning, provided the mean stand diameter is at least 8 inches.

Precommercial thinning.--Smaller stands with surplus stocking are precommercial thinning opportunities, provided stand height is between 10 and 30 feet. Such thinnings should increase timber yields.

Cleaning or release.--Sometimes conifer seedling and sapling stands are intermixed with brush and small hardwoods. If this broadleaf competition threatens to crowd and overtop the conifers, a cleaning or release is needed.

Improvement cutting.--When large hardwoods and cull conifers are using valuable growing space and competing with crop trees, an improvement cut is prescribed.

Planting .--Areas with little or no conifer stocking are considered planting opportunities, usually preceded by site preparation.

Stand conversion.--When the site is already occupied by trees that are neither presently nor prospectively merchantable and are too large for herbicide treatment, a stand conversion is called for.

Planting of openings.--Seedling and sapling stands with large, nonstocked openings are identified separately as opportunities for planting (fig. 13).

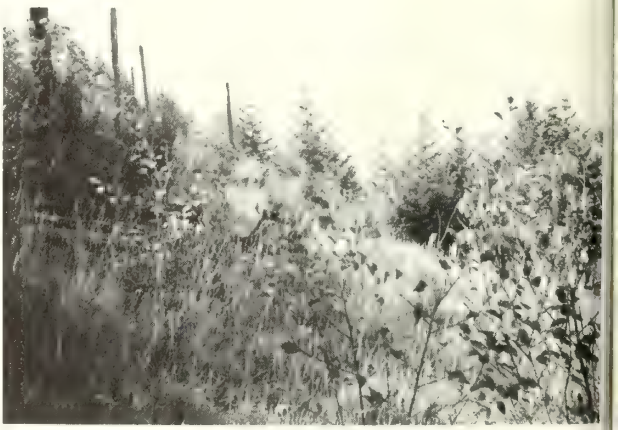


Figure 13.--Large openings need to be planted if full production is to be achieved in the future.

We have not attempted to quantify the increases in yields that can be achieved through treatment nor have we made any assessment of the economic feasibility of treatment.

THE NATIONAL FOREST AND BLM LANDS

Lands administered by the U.S. Forest Service and by the Bureau of Land Management are predominantly stocked with stands of mature timber--mature in the sense that growth rates have slowed down. There are 630,000 acres of this timber on National Forest and another 335,000 acres on BLM lands. In a regulated forest, these stands would be harvested as they reached rotation age. In an unregulated mature forest, such a policy would lead to immediate liquidation of most of the growing stock. Both National Forest and BLM policies dictate an allowable annual harvest that does not exceed the future annual harvest attainable under management--one which will not decline after the old-growth timber is gone. To implement this policy, the Federal agencies will harvest current inventory relatively slowly over many decades. In the meantime, most of the existing forest will be stored on the stump. If growth continues to exceed mortality, inventory loss during storage may be minimal. By scheduling harvest in the most decadent stands first and by sanitation salvage logging, the Federal agencies hope to forestall or capture part of the mortality.

The opportunities for silvicultural treatment on Federal lands are:

Treatment	Bureau of Land Management	National Forest
	(Thousand acres)	
Harvest:		
Regeneration cutting	335	630
Commercial thinning	10	47
Reduce competition:		
Precommercial thinning	42	49
Cleaning or release	25	2
Improvement cutting	10	--
Plant:		
Site preparation and planting	8	22
Site preparation and planting of openings	58	32
Stand conversion	5	--
No current treatment recommended:		
Recent clearcut	15	4
Satisfactory stocking	89	46
Treatment impractical:		
High elevation low site	--	65
Tough site areas	12	--
Total commercial forest area	609	897

At least 40 percent of the mature timber on National Forest land and at least 25 percent of the mature timber on BLM land will be harvested by some form of partial cutting. Shelterwood cutting is often used to protect nontimber resource values or because tough site regeneration problems make clearcutting inadvisable. In some cases, restrictive cutting regulations will reduce future yields; in other instances, yields may be improved by prompt regeneration.

In addition to the mature timber mentioned above, there are 49,000 acres of mature timber growing on low sites at higher elevations on the Umpqua National Forest and 16,000 similar acres growing immature timber. These small diameter stands with comparatively low productivity and limited merchantability are unlikely to be intensively managed for timber production.

Only 5 percent of National Forest timber and 2 percent of BLM timber are suitable for commercial thinning. Many of the opportunities for treatment in National Forests are in stands which, although relatively young, are past the usual rotation age. Such stands, when still young and vigorous enough to respond, are scheduled for commercial thinning because the long storage period precludes early final harvest.

Opportunities for other types of cultural activities are limited in these predominantly old-growth forests. Dense sapling stands suitable for precommercial thinning are found on only 6 percent of the Federally owned commercial forest land. Site preparation and planting are needed on 22,000 acres of National Forest land and 8,000 acres of BLM land. An additional 32,000 acres on National Forests and 58,000 acres on BLM land are occupied by young stands with openings that could be planted after suitable site preparation. Typically, the planting backlog is on tough sites where the cost of successful regeneration will be high. Inventory data showed only a scattered acreage of young stands in need of release from competing hardwoods, shrubs, and other plants. However, data on competing vegetation were not collected on the Federal agency inventories and could only be inferred from hardwood tally and cover classes. The actual acreage in need of release could be considerably larger than reported here.

There are 12,000 acres of BLM land classed as "treatment unknown" in stands of mixed age and mixed species on tough sites. Current productivity is very low in these stands, with hardwood species such as madrone predominating. The prescription would be "stand conversion" except for the high risk of regeneration failure. More research is needed on how to replace these stands with more productive ones.

A considerable acreage--104,000 acres of BLM land and 50,000 acres of National Forest land--was placed in "no current treatment" (includes recently cutover acreage scheduled for planting). Some of these acres represent recent clearcuts scheduled for planting. Others are stocked with dense regeneration too young to be precommercially thinned. Many acres, however, are too sparse to qualify for thinning. Such stands may be fully utilizing the site or they may be understocked but too old for interplanting. The latter type of stand will probably be fully stocked by maturity, but intermediate harvests are likely to be forgone.

In summary, opportunities for cultural practices other than harvest cutting are limited on Federal land in Douglas County. Because of the relative scarcity of immature stands, the opportunities will probably remain limited for some years.

FOREST INDUSTRY LANDS

Only one-fourth of forest industry's commercial forest area is stocked with mature timber ready for harvest. If present harvest levels continue, most of these stands will be logged within 20 years, presenting opportunities for intensive management of the new stands that replace them. In the meantime, these stands, like those on Federal forest land, present little opportunity for silvicultural treatment other than sanitation salvage of dead and weakened trees.

Unlike the Federal forests, a substantial portion of industrial lands have been cutover, creating opportunities for young-growth management. Future yields on the one-tenth of the commercial forest area that is in dense regeneration could be increased by precommercial thinning (fig. 14). Almost as many acres of immature conifer stands are growing slowly because of severe competition from brush and hardwoods.

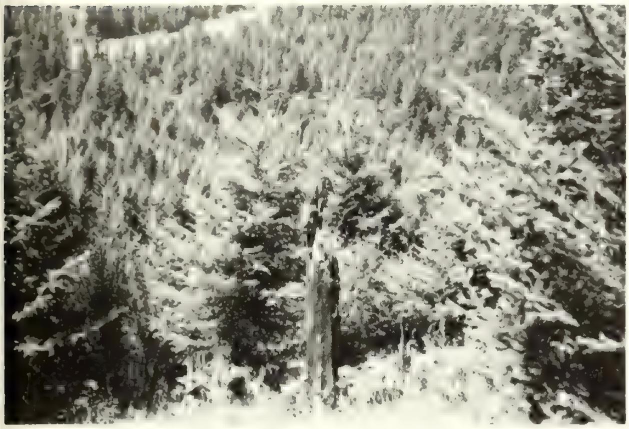


Figure 14.--Precommercial thinning opportunities are concentrated on forest industry lands.

Of the industrial forest land 8 percent is growing madrone, cull remnants left after logging, and other unsalvable material. This land will not be productive until it is cleared and planted--an expensive undertaking. An additional 18 percent is occupied by varying amounts of brush, ferns, grass, and hardwood saplings. Site preparation and planting are needed before this land will contribute to future timber supplies. On another 11 percent of the area, clumps of conifer regeneration alternate with nonstocked openings. Site preparation and planting of these openings could increase future timber yields.

Finally, 14 percent of the forest industry-owned land is not now suitable for silvicultural treatment. Two percent is recent cutover scheduled for planting, 3 percent is reforested with trees too young for thinning, 3 percent is understocked with immature stands too old for interplanting, and 2 percent is on tough sites where timber values are low and silvicultural treatments are likely to fail. The remaining 4 percent of the area is stocked at the level recommended for maximum timber production.

Acreages available for silvicultural treatment are:

Treatment	Area (Thousand acres)
Harvest:	
Regeneration cutting	210
Commercial thinning	14
Reduce competition:	
Precommercial thinning	87
Cleaning or release	59
Improvement cutting	8
Plant:	
Site preparation and planting	140
Site preparation and planting of openings	83
Stand conversion	65
No current treatment:	
Recent clearcut	14
Satisfactory stocking	79
Treatment impractical:	
Tough site areas	14
Total commercial forest area	773

In the long run, the single greatest opportunity to increase timber supplies is through site preparation and planting. Over 200,000 acres of industrial forest land in Douglas County is unproductive for lack of conifer stocking.

An additional 83,000 acres are stocked with patches of conifer trees interspersed with patches of brush and hardwoods (fig. 15). Although these lands could be highly productive if properly stocked with conifers, treatment would be expensive. Much of the land has been out of production for 20 or more years and is now supporting a lush growth of brush and hardwoods. A separate study is needed to determine the costs associated with treatment.

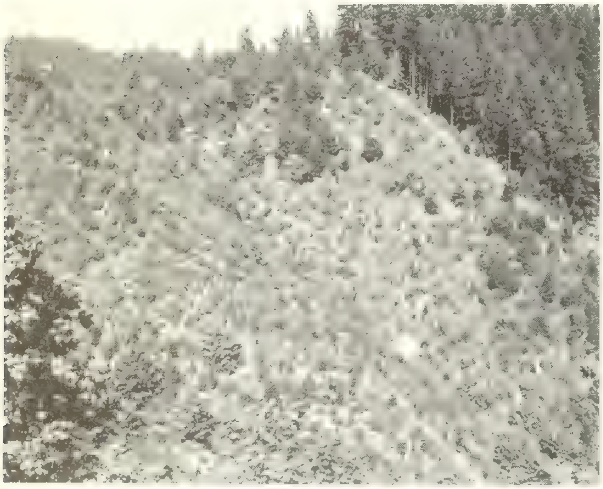


Figure 15.--Although clearcut 10-15 years ago, some forest industry lands remain poorly stocked. This is a tough site stocked with madrone and canyon live oak.

OTHER PRIVATE LANDS

Other private forest lands support little mature timber. Only 48,000 acres are ready for harvest, and half of these have already been partially cut. There are few opportunities for thinning or release from overtopping brush or hardwoods. About 10 percent of the area does not need treatment because it is stocked at or near the recommended level for timber production.

The opportunities for silvicultural treatment on commercial forest lands of other private owners are:

Treatment	Area (Thousand acres)
Harvest:	
Regeneration cutting	48
Commercial thinning	4
Reduce competition:	
Precommercial thinning	8
Cleaning or release	13
Plant:	
Site preparation and planting	40
Site preparation and planting of openings	38
Stand conversion	25
No current treatment:	
Recent clearcut	4
Satisfactory stocking	30
Treatment impractical:	
Nonstocked tough sites	96
Total commercial forest land	306

The predominant silvicultural opportunity on these private lands is site preparation and planting. Less than half the commercial forest land held by other private owners is now producing conifers; 8 percent is currently stocked with madrone, cull conifers, and other unsalable material. Another 13 percent is stocked with varying amounts of brush, hardwood saplings, bracken fern, and grass; an equal area is covered by a mixture of brush, and conifer clumps. Finally, 31 percent is in brushy cutover sites too hot and dry to successfully regenerate after they are clearcut.[3] These tough sites were almost all clearcut in the late 1940's and have failed to restock. Efforts to reforest these areas would be expensive and uncertain of success. Furthermore, even after complete regeneration, yields would probably not exceed 50 cubic feet per acre per year.

---

[3] Richard E. Carkin and Don Minore. Harvest cutting prescriptions based on an environmental classification. Report on file at Forestry Sciences Laboratory, Pacific Northwest Forest and Range Experiment Station, Corvallis, Oregon.

Although other private lands are in poorer condition for timber production than other lands, they offer few attractive opportunities for investment in silvicultural treatment. Typically, they are cutover lands at lower elevations on hot dry sites with lower than average productivity. Most areas were logged after World War II and have never restocked. Treatment now would be difficult and expensive.

OTHER PUBLIC LANDS

Because State, county, and municipal lands were sampled with only a few field plots, the inventory provides only an indication of the condition of these lands. In general, lands in this group resemble those belonging to forest industry; conclusions reached there are probably applicable to State, county, and municipal lands as well.

Treatment	Area
	(Thousand acres)
Harvest:	
Regeneration cutting	18
Reduce competition:	
Cleaning or release	8
Precommercial thinning	6
Plant:	
Site preparation and planting	12
No treatment:	
Acceptable stocking	12
Total commercial forest land	56

Conclusion

Douglas County still has a large inventory of conifer sawtimber--63.9 billion board feet--but 76 percent of it is publicly owned. Declining inventories will necessitate substantial reductions in the private timber harvest during the next two decades.

About half of Douglas County's commercial forest area is either occupied by stands too young for harvest or is nonstocked. Many of these acres are growing less than their productive capacity either because of sparse or overly dense stocking or because of excessive competition from brush and hardwoods. A summary of these treatment opportunities follows:

Treatment	Acres available for treatment	Percent of total commercial forest area
Plant or start over	317,000	12
Plant openings in stand	211,000	8
Remove broadleaf competition	125,000	5
Precommercial thinning	192,000	7
Total precommercial treatment opportunities	845,000	32

In the long run, Douglas County's timber supply will come from the acres treated and from the stands that will be formed after harvest of the remaining old growth. It is therefore significant that 20 percent of the commercial forest land in the county needs planting. Although poor stocking is, in part, a result of past inattention, this is not the whole story. In much of Douglas County, regeneration problems present a real challenge to the land manager. Repeated plantation failures are common, particularly in the South Umpqua drainage. If regeneration failures are to be avoided, more research is needed in regeneration techniques on tough sites. The rehabilitation of nonstocked lands will require both research and a large investment in site preparation and planting.

Tables

METRIC CONVERSIONS

1,000 acres = 404.69 hectares
1,000 cubic feet = 28.3 cubic meters
1 cubic foot per acre = 0.0700 cubic meter per hectare
1 square foot basal area per acre = 0.2296 square meter per hectare
1 foot = 30.48 centimeters

Table 1.--Area by land class, Douglas County, Oregon, January 1, 1974

(In thousand acres)

Land class	Area
Forest land:	
Commercial	2,641
Productive reserved	7
Unproductive	150
Total	2,798
Nonforest land[1]	442
Total area[2]	3,240

[1] Includes cropland, pasture and range, swampland, industrial and urban areas, powerline clearings, railroads, all improved roads and highways, and water as classified by Forest Survey standards but defined by the Bureau of Census as land.

[2] Source: United States Bureau of the Census, Land and Water Area of the United States, 1970.

Table 2.--Area of commercial forest land by ownership class, Douglas County, Oregon, January 1, 1974

(In thousand acres)

Ownership class	Area
National Forest	897
Other public:	
Bureau of Land Management	609
State	48
County and municipal	8
Total	665
Private:	
Forest industry	773
Other private:	
Farmer owned	235
Miscellaneous	71
Total	1,079
All ownerships	2,641

Table 3.--Area of commercial forest land by cubic-foot site and ownership classes, Douglas County, Oregon, January 1, 1974

(In thousand acres)

Site class[1] (cubic feet)	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
225 or more	22	4	1	--	17	--
165 to 224	191	53	41	9	73	15
120 to 164	974	253	267	19	396	39
85 to 119	754	274	152	8	207	113
50 to 84	566	284	140	8	37	97
20 to 49	134	29	8	12	43	42
All classes	2,641	897	609	56	773	306

[1] A classification in terms of capacity for cubic-foot annual growth per acre at culmination of mean annual growth in fully stocked natural stands.

Table 4.--Area of commercial forest land on conifer sites[1] by ownership, conifer stocking, and stand-size classes, Douglas County, Oregon, January 1, 1974

(In thousand acres)

Ownership and conifer stocking classes	Stand-size class					Total
	Large sawtimber	Small sawtimber	Poletimber	Seedlings and saplings	Nonstocked	
National Forest:						
Full	433	120	38	76	--	667
Moderate	102	33	5	14	--	154
Poor	19	6	2	27	--	54
Nonstocked	--	--	--	--	22	22
Total	554	159	45	117	22	897
Bureau of Land Management:						
Full	173	32	10	67	--	282
Moderate	111	17	10	77	--	215
Poor	30	8	2	43	--	83
Nonstocked	--	--	--	--	29	29
Total	314	57	22	187	29	609
Other public:						
Full	9	--	12	--	--	21
Moderate	3	--	--	--	--	3
Poor	--	5	--	--	--	5
Nonstocked	--	--	--	--	15	15
Total	12	5	12	--	15	44
Forest industry:						
Full	51	35	--	70	--	156
Moderate	96	64	24	53	--	237
Poor	56	33	28	158	--	275
Nonstocked	--	--	--	--	105	105
Total	203	132	52	281	105	773
Other private:						
Full	--	1	7	7	--	15
Moderate	22	22	12	32	--	88
Poor	6	28	22	14	--	70
Nonstocked	--	--	--	--	133	133
Total	28	51	41	53	133	306
Grand total	1,111	404	172	638	304	2,629

[1] Excludes 12,000 acres of commercial forest land on hardwood sites.

Table 5.--Area of commercial forest land by forest type and ownership class, Douglas County, Oregon, January 1, 1974

(In thousand acres)

Forest type	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Douglas-fir	1,735	593	538	24	505	75
White fir	12	12	--	--	--	--
Shasta red fir	27	27	--	--	--	--
Grand fir	48	20	1	--	10	17
Subalpine fir	5	5	--	--	--	--
Pacific silver fir	14	14	--	--	--	--
Noble fir	18	18	--	--	--	--
Ponderosa pine	21	5	2	--	9	5
Jeffrey pine	23	--	--	--	23	--
Sugar pine	5	5	--	--	--	--
Western white pine	2	2	--	--	--	--
Lodgepole pine	65	65	--	--	--	--
Sitka spruce	4	--	--	--	4	--
Mountain hemlock	57	57	--	--	--	--
Western hemlock	71	29	18	--	24	--
Incense-cedar	43	5	3	--	--	35
Port-Orford-cedar	10	--	--	--	10	--
Western redcedar	41	4	6	--	31	--
Red alder	44	8	4	12	13	7
Maple	22	--	4	--	10	8
California black oak	2	--	--	--	2	--
Oregon white oak	64	--	--	8	--	56
Chinkapin	5	4	1	--	--	--
Madrone	126	2	8	--	47	69
Other commercial hardwoods	37	--	1	12	20	4
Noncommercial hardwoods	8	--	1	--	--	7
Nonstocked	132	22	22	--	65	23
All types	2,641	897	609	56	773	306

Table 6.--Volume of growing stock and sawtimber on commercial forest land by ownership class and by softwoods and hardwoods, Douglas County, Oregon, January 1, 1974

Ownership class	Average volume per acre	All species	Softwoods	Hardwoods
	Cubic feet	- - - - - *Million cubic feet* - - - - -		
Growing stock:[1]				
National Forest	6,173	5,537	5,469	68
Bureau of Land Management	4,695	2,859	2,648	211
Other public	2,946	165	114	51
Forest industry	2,517	1,946	1,821	125
Other private	1,098	336	245	91
All ownerships	4,106	10,843	10,297	546
	Board feet	- - - - - *Million board feet* - - - - -		
Sawtimber (International 1/4-inch rule):[2]				
National Forest	36,443	32,689	32,274	415
Bureau of Land Management	27,117	16,514	15,805	709
Other public	19,625	1,099	824	275
Forest industry	18,082	13,977	13,596	381
Other private	5,216	1,596	1,430	166
All ownerships	24,943	65,875	63,929	1,946
Sawtimber (Scribner rule):[3]				
National Forest	28,415	25,488	25,212	276
Bureau of Land Management	25,133	15,306	14,607	699
Other public	15,054	843	620	223
Forest industry	13,935	10,772	10,461	311
Other private	3,376	1,033	894	139
All ownerships	20,236	53,442	51,794	1,648

[1] Includes trees 5.0 inches in d.b.h. and larger.

[2] Includes softwood trees 9.0 inches in d.b.h. and larger and hardwood trees 11.0 inches in d.b.h. and larger.

[3] Includes trees 11.0 inches in d.b.h. and larger.

Table 7.--Net volume of growing stock on commercial forest land by species and ownership class, Douglas County, Oregon, January 1, 1974

(In million cubic feet)

Species	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	7,492	3,633	2,181	109	1,431	138
True firs	731	643	59	1	15	13
Ponderosa and Jeffrey pines	156	48	20	--	73	15
Sugar pine	241	166	43	--	32	--
Western white pine	90	87	3	--	--	--
Lodgepole pine	94	94	--	--	--	--
Hemlocks	970	616	194	(1)	154	6
Incense-cedar	258	98	65	4	22	69
Western redcedar	243	66	83	--	90	4
Other softwoods[2]	22	18	--	--	4	--
Total	10,297	5,469	2,648	114	1,821	245
Hardwoods:						
Red alder	162	54	27	44	25	12
Other hardwoods[3]	384	14	184	7	100	79
Total	546	68	211	51	125	91
All species	10,843	5,537	2,859	165	1,946	336

[1] Less than 500,000 cubic feet.

[2] Includes knobcone pine, Port-Orford-cedar, and Engelmann and Sitka spruces.

[3] Includes bigleaf maple, madrone, golden chinkapin, Oregon ash, cottonwood, oaks, and California laurel (Oregon myrtle).

Table 8.--Net volume of growing stock on commercial forest land by species and ownership class, Douglas County, Oregon, January 1, 1974 (International 1/4-inch rule)

(In million board feet)

Species	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	48,534	23,022	13,284	786	10,727	715
True firs	3,974	3,507	306	6	88	67
Ponderosa and Jeffrey pines	1,115	326	123	--	551	115
Sugar pine	1,639	1,124	263	--	252	--
Western white pine	500	484	16	--	--	--
Lodgepole pine	176	176	--	--	--	--
Hemlocks	4,966	2,722	1,067	4	1,132	41
Incense-cedar	1,473	520	323	28	139	463
Western redcedar	1,437	299	423	--	686	29
Other softwoods[1]	115	94	--	--	21	--
Total	63,929	32,274	15,805	824	13,596	1,430
Hardwoods:						
Red alder	835	358	126	246	93	12
Other hardwoods[2]	1,111	57	583	29	288	154
Total	1,946	415	709	275	381	166
All species	65,875	32,689	16,514	1,099	13,977	1,596

[1] Includes knobcone pine, Port-Orford-cedar and Engelmann and Sitka spruces.

[2] Includes bigleaf maple, madrone, golden chinkapin, Oregon ash, cottonwood, oaks, and California laurel (Oregon myrtle).

Table 9.--Net volume of growing stock on commercial forest land by species and ownership class, Douglas County, Oregon, January 1, 1974 (Scribner rule)

(In million board feet)

Species	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	39,799	17,972	12,360	598	8,452	417
True firs	3,106	2,755	269	--	44	38
Ponderosa and Jeffrey pines	842	257	115		387	83
Sugar pine	1,323	876	256	--	191	--
Western white pine	393	379	14	--	--	--
Lodgepole pine	136	136	--	--	--	--
Hemlocks	3,820	2,123	912	2	755	28
Incense-cedar	1,129	405	299	20	95	310
Western redcedar	1,160	234	382	--	526	18
Other softwoods[1]	86	75	--	--	11	--
Total	51,794	25,212	14,607	620	10,461	894
Hardwoods:						
Red alder	644	234	125	199	76	10
Other hardwoods[2]	1,004	42	574	24	235	129
Total	1,648	276	699	223	311	139
All species	53,442	25,488	15,306	843	10,772	1,033

[1] Includes knobcone pine, Port-Orford-cedar, Engelmann and Sitka spruces.

[2] Includes bigleaf maple, madrone, golden chinkapin, Oregon ash, cottonwood, oaks, and California laurel (Oregon myrtle).

Table 10.--Volume of timber on commercial forest land by class of timber and by softwoods and hardwoods, Douglas County, Oregon, January 1, 1974

(In million cubic feet)

Class of timber	All species	Softwoods	Hardwoods
Sawtimber trees:			
Saw-log portion	9,275	8,944	331
Upper-stem portion	910	873	37
Total	10,185	9,817	368
Poletimber trees	658	480	178
All growing stock trees	10,843	10,297	546
Sound cull trees	210	45	165
Rotten cull trees	384	353	31
Salvable dead trees	204	204	--
All timber	11,641	10,899	742

Table 11.--Net annual growth of growing stock and sawtimber on commercial forest land by ownership class and by softwoods and hardwoods, Douglas County, Oregon, January 1, 1974

Ownership class	Average volume per acre	All species	Softwoods	Hardwoods
	Cubic feet	- - - - - --*Thousand cubic feet* - - - - -		
Growing stock:[1]				
National Forest	39	34,600	34,100	500
Bureau of Land Management	35	21,400	16,500	4,900
Other public	52	2,900	2,500	400
Forest industry	22	20,200	17,500	2,700
Other private	56	17,100	11,000	6,100
All ownerships	36	96,200	81,600	14,600
	Board feet	- - - - - *Thousand board feet* - - - - -		
Sawtimber (International 1/4-inch rule):[2]				
National Forest	232	207,800	202,800	5,000
Bureau of Land Management	161	98,000	83,900	14,100
Other public	213	11,900	8,700	3,200
Forest industry	202	156,400	133,400	23,000
Other private	207	63,400	58,800	4,600
All ownerships	203	537,500	487,600	49,900
Sawtimber (Scribner rule):[3]				
National Forest	181	162,800	159,800	3,000
Bureau of Land Management	150	91,400	77,500	13,900
Other public	146	8,200	5,300	2,900
Forest industry	121	93,800	76,600	17,200
Other private	138	42,200	38,400	3,800
All ownerships	151	398,400	357,600	40,800

[1] Includes trees 5.0 inches in d.b.h. and larger.

[2] Includes softwood trees 9.0 inches in d.b.h. and larger and hardwood trees 11.0 inches in d.b.h. and larger.

[3] Includes trees 11.0 inches in d.b.h. and larger.

Table 12.--Net annual growth of growing stock on commercial forest land by species and ownership class, Douglas County, Oregon, January 1, 1974

(In thousand cubic feet)

Species	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	55,400	20,000	12,600	2,600	11,600	8,600
True firs	7,500	5,000	900	100	700	800
Ponderosa and Jeffrey pines	1,100	200	100	--	500	300
Sugar pine	[1]-200	--	(2)	[1]-200	(2)	--
Western white pine	[1]-1,200	[1]-1,200	(2)	--	--	--
Lodgepole pine	1,000	1,000	--	--	--	--
Hemlocks	12,600	6,900	2,000	(2)	3,500	200
Incense-cedar	2,300	800	300	(2)	200	1,000
Western redcedar	2,500	1,100	600	--	700	100
Other softwoods[3]	600	300	--	--	300	--
Total	81,600	34,100	16,500	2,500	17,500	11,000
Hardwoods:						
Red alder	3,100	400	700	300	900	800
Other hardwoods[4]	11,500	100	4,200	100	1,800	5,300
Total	14,600	500	4,900	400	2,700	6,100
All species	96,200	34,600	21,400	2,900	20,200	17,100

[1] Negative net annual growth is the result of net annual mortality exceeding gross annual growth.

[2] Less than 50,000 cubic feet.

[3] Includes knobcone pine, Port-Orford-cedar, and Sitka spruce.

[4] Includes bigleaf maple, madrone, golden chinkapin, Oregon ash, cottonwood, oaks, and California laurel (Oregon myrtle).

Table 13.--Net annual growth of sawtimber on commercial forest land by species and ownership class, Douglas County, Oregon, January 1, 1974 (International 1/4-inch rule)

(In thousand board feet)

Species	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	326,200	131,900	66,700	9,600	74,400	43,600
True firs	38,200	28,500	2,400	400	3,900	3,000
Ponderosa and Jeffrey pines	10,700	2,400	200	--	4,800	2,900
Sugar pine	900	2,200	[1]-100	[1]-1,300	(2)	--
Western white pine	[1]-5,900	[1]-6,100	200	--	--	--
Lodgepole pine	4,600	4,600	--	--	--	--
Hemlocks	79,100	29,300	10,000	200	38,600	1,100
Incense-cedar	13,800	3,300	1,300	[1]-200	1,900	7,500
Western redcedar	15,800	4,300	2,800	--	8,000	700
Other softwoods[3]	4,200	2,400	--	--	1,800	--
Total	487,600	202,800	83,900	8,700	133,400	58,800
Hardwoods:						
Red alder	13,000	4,000	3,000	2,700	3,100	200
Other hardwoods[4]	36,900	1,000	11,100	500	19,900	4,400
Total	49,900	5,000	14,100	3,200	23,000	4,600
All species	537,500	207,800	98,000	11,900	156,400	63,400

[1] Negative net annual growth is the result of net annual mortality exceeding gross annual growth.

[2] Less than 50,000 board feet.

[3] Includes knobcone pine, Port-Orford-cedar, and Sitka spruce.

[4] Includes bigleaf maple, madrone, golden chinkapin, Oregon ash, cottonwood, oaks, and California laurel (Oregon myrtle).

Table 14.--Average annual mortality of growing stock and sawtimber on commercial forest land by ownership class and by softwoods and hardwoods, Douglas County, Oregon, January 1, 1974

Ownership class	Average volume per acre	All species	Softwoods	Hardwoods
	Cubic feet	- - - - - *Thousand cubic feet* - - - - -		
Growing stock:[1]				
National Forest	23	20,600	20,000	600
Bureau of Land Management	33	20,400	18,700	1,700
Other public	20	1,100	800	300
Forest industry	17	13,100	11,600	1,500
Other private	3	900	400	500
All ownerships	21	56,100	51,500	4,600
	Board feet	- - - - - *Thousand board feet* - - - - -		
Sawtimber (International 1/4-inch rule):[2]				
National Forest	135	121,000	117,000	4,000
Bureau of Land Management	177	107,800	103,800	4,000
Other public	134	7,500	5,800	1,700
Forest industry	100	77,100	75,400	1,700
Other private	5	1,400	1,200	200
All ownerships	119	314,800	303,200	11,600
Sawtimber (Scribner rule):[3]				
National Forest	104	93,000	91,000	2,000
Bureau of Land Management	139	84,700	80,800	3,900
Other public	101	5,700	4,400	1,300
Forest industry	73	56,600	55,100	1,500
Other private	3	900	700	200
All ownerships	91	240,900	232,000	8,900

[1] Includes trees 5.0 inches in d.b.h. and larger.

[2] Includes softwood trees 9.0 inches in d.b.h. and larger and hardwood trees 11.0 inches in d.b.h. and larger.

[3] Includes trees 11.0 inches in d.b.h. and larger.

Table 15.--Average annual mortality of growing stock on commercial forest land by species and ownership class, Douglas County, Oregon, January 1, 1974

(In thousand cubic feet)

Species	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	34,700	10,100	14,800	500	9,000	300
True firs	4,600	3,700	900	--	--	(1)
Ponderosa and Jeffrey pines	1,200	100	300	--	700	100
Sugar pine	2,600	1,200	800	200	400	--
Western white pine	1,800	1,700	100	--	--	--
Lodgepole pine	1,000	1,000	--	--	--	--
Hemlocks	4,000	2,100	1,000	--	900	--
Incense-cedar	700	(1)	500	100	100	--
Western redcedar	800	(1)	300	--	500	--
Other softwoods[2]	100	100	--	--	--	--
Total	51,500	20,000	18,700	800	11,600	400
Hardwoods:						
Red alder	1,700	600	600	300	100	100
Other hardwoods[3]	2,900	--	1,100	--	1,400	400
Total	4,600	600	1,700	300	1,500	500
All species	56,100	20,600	20,400	1,100	13,100	900

[1] Less than 50,000 cubic feet.

[2] Includes knobcone pine, Port-Orford-cedar, and Sitka spruce.

[3] Includes bigleaf maple, madrone, golden chinkapin, cottonwood, and oaks.

Table 16.--Average annual mortality of sawtimber on commercial forest land by species and ownership class, Douglas County, Oregon, January 1, 1974 (International 1/4-inch rule)

(In thousand board feet)

Species	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	217,500	66,500	83,700	4,000	62,800	500
True firs	26,100	21,100	5,000	--	--	--
Ponderosa and Jeffrey pines	7,100	700	1,400	--	4,300	700
Sugar pine	16,300	7,700	4,100	1,400	3,100	--
Western white pine	11,400	10,600	800	--	--	--
Lodgepole pine	1,900	1,900	--	--	--	--
Hemlocks	18,000	8,200	5,400	--	4,400	--
Incense-cedar	2,700	100	1,900	400	300	--
Western redcedar	2,100	100	1,500	--	500	--
Other softwoods[1]	100	100	--	--	--	--
Total	303,200	117,000	103,800	5,800	75,400	1,200
Hardwoods:						
Red alder	7,900	3,900	2,000	1,700	300	--
Other hardwoods[2]	3,700	100	2,000	--	1,400	200
Total	11,600	4,000	4,000	1,700	1,700	200
All species	314,800	121,000	107,800	7,500	77,100	1,400

[1] Includes knobcone pine, Port-Orford-cedar, and Sitka spruce.

[2] Includes bigleaf maple, madrone, golden chinkapin, cottonwood, and oaks.

Table 17.--Timber harvest by ownership class, Douglas County, Oregon, 1950-73 (International 1/4-inch scale)

(In million board feet)

Year	All ownerships	Private	National Forest	Bureau of Land Management	Other public
1950	1,355	1,054	151	131	19
1951	1,607	1,333	156	109	9
1952	1,932	1,616	149	167	--
1953	1,779	1,414	177	188	--
1954	1,893	1,377	247	268	1
1955	2,352	1,902	265	184	--
1956	2,116	1,624	287	202	3
1957	1,556	1,108	205	236	7
1958	1,605	1,032	287	273	13
1959	1,895	1,120	396	367	12
1960	1,822	1,212	294	298	18
1961	1,245	575	333	304	33
1962	1,542	722	427	361	32
1963	1,499	605	453	427	14
1964	1,862	776	574	466	46
1965	1,936	856	638	404	38
1966	1,735	817	476	404	38
1967	1,718	858	402	427	31
1968	2,161	981	571	587	22
1969	1,966	1,041	501	381	43
1970	1,630	839	407	361	23
1971	1,870	875	470	489	36
1972	1,851	856	564	407	24
1973	1,749	710	548	452	39

Table 18.--Area by treatment and ownership class, Douglas County, Oregon, January 1, 1974

(In thousand acres)

Treatment	Bureau of Land Management	National Forest	Other public	Forest industry	Other private	Total
Regeneration cut	335	630	18	210	48	1,241
Commercial thinning	10	47	--	14	4	75
Improvement cutting	10	--	--	8	--	18
No treatment[1]	104	50	12	93	34	293
Precommercial thinning (stand)	39	49	6	69	8	171
Precommercial thinning (clumps)	3	--	--	18	--	21
Cleaning or release	25	2	8	59	13	107
Site preparation and plant openings	58	32	--	83	38	211
Site preparation and plant entire area	8	22	12	140	40	222
Tough site[2] areas	12	--	--	14	96	122
Stand conversion	5	--	--	65	25	95
High elevation low site	--	65	--	--	--	65
Total	609	897	56	773	306	2,641

[1] Includes recent cutover scheduled for planting.
[2] Harsh sites with shallow soil.

Stocking

Stocking measures how well the productive potential of the forest is being utilized by trees. It is both a useful measure of the condition of the forest and a basis for assessing treatment opportunities. Stands with more than enough trees to realize the productive potential of the site may be candidates for thinning, and stands with low stocking may need reinforcement planting or replacement.

In general, stocking standards are based on normal yield tables such as USDA Technical Bulletin No. 201 (McArdle et al. 1961). However, some sites, because of hot dry conditions, serpentine soils, rock outcrops, or other restrictions, are unable to support the density of trees indicated by the normal yield tables. On such areas, stocking standards are adjusted to reflect lower stocking capacity, using the techniques outlined by MacLean and Bolsinger (1973).

For this report, we have grouped stocking into four broad classes: fully stocked, moderately stocked, poorly stocked, and nonstocked. In rating stocking, we have considered only conifer trees except where hardwood trees are growing on hardwood sites. Stands with a mean diameter[4] of at least 8 inches and a normal stocking density of at least 60 percent are classed as fully stocked. We assume that these stands fully occupy the site. Moderately stocked stands with a mean diameter of at least 8 inches are stocked to a density of 36-59 percent of normal. When normal stocking levels are between 10 and 35 percent, the stands are classed as poorly stocked. Stands with less than 10 percent stocking are considered nonstocked. In this report, we have often combined full and moderate stocking into a single class--satisfactorily stocked.

Stands with a mean diameter of less than 8 inches are treated a little differently. Stocking level for such stands does not indicate the current level of site utilization but rather suggests the degree to which the stands can be expected to utilize the site when their mean diameter reaches 8 inches--the time when a commercial thinning first becomes feasible. Fully stocked regeneration stands can be expected to produce full yields of both intermediate and final harvests. Moderately stocked regeneration should also provide full yield at final harvest, but intermediate harvests may be forgone. Poorly stocked stands are unlikely to provide full yield, even at final harvest.

The following tabulation indicates the number of seedlings necessary to meet the above standards. As stand diameter increases, fewer trees are required.

Species	Poorly stocked	Moderately stocked	Fully stocked
Douglas-fir	72-256	257-428	429+
Western hemlock and true firs	99-344	345-591	592+
Ponderosa pine	73-255	256-438	439+

---

[4] In this report, mean diameter refers to the diameter of the tree of average basal area.

The standards used here and those used in measuring compliance with the Oregon Forest Practices Act (ORS 527.680; Forest Practice Rules, OAR 24-600 through 24-604) are not directly comparable. Ours relates to fiber productivity potential, and the Forest Practices Act sets a minimum socially acceptable standard. In general, though, stands that we classed as moderately or fully stocked will meet State standards as will many of the stands classed as poorly stocked. The nonstocked areas and some of the poorly stocked areas will not meet the standards adopted by the State of Oregon.

Plant Species

This list includes the important tree species occurring in Douglas County. The source for scientific names is Little (1953).

Scientific name	Common name	Douglas County
Softwood trees:		
Abies amabilis (Dougl.) Forbes	Pacific silver fir	High elevations of Cascade Range
Abies concolor (Gord. & Glend.) Lindl.	white fir	Cascade Range in South Umpqua drainage
Abies grandis (Dougl.) Lindl.	grand fir	Coast Ranges and North Umpqua
Abies lasiocarpa (Hook.) Nutt.	subalpine fir	High elevations of Cascade Range
Abies magnifica var. *shastensis* Lemm.	Shasta red fir	High elevations of Cascade Range
Abies procera Rehd.	noble fir	High elevations of Cascade Range
Chamaecyparis lawsoniana (A. Murr.) Parl.	Port-Orford-cedar	Cow Creek
Chamaecyparis nootkatensis (D. Don) Spach	Alaska-cedar	High elevations of Cascade Range
Libocedrus decurrens Torr.	incense-cedar	Interior valleys and Cascade Range
Picea engelmannii Parry	Engelmann spruce	High elevations of Cascade Range
Picea sitchensis (Bong.) Carr.	Sitka spruce	Coast Ranges
Pinus albicaulis Engelm.	whitebark pine	At timberline in Cascade Range
Pinus attenuata Lemm.	knobcone pine	Interior valleys and Cascade Range
Pinus contorta Dougl.	lodgepole pine	Cascade Range
Pinus jeffreyi Grev. & Balf.	Jeffrey pine	Interior valleys on serpentine soil
Pinus lambertiana Dougl.	sugar pine	Interior valleys and Cascade Range

Scientific name	Common name	Where found in Douglas County
Pinus monticola Dougl.	western white pine	High elevations of Cascade Range
Pinus ponderosa Laws.	ponderosa pine	Interior valleys and Cascade Range
Pseudotsuga menziesii (Mirb.) Franco	Douglas-fir	All parts
Taxus brevifolia Nutt.	Pacific yew	All parts
Thuja plicata Donn	western redcedar	All parts
Tsuga heterophylla (Raf.) Sarg.	western hemlock	Coast and Cascade Ranges
Tsuga mertensiana (Bong.) Carr.	mountain hemlock	High elevations of Cascade Range
Hardwood trees:		
Acer macrophyllum Pursh	bigleaf maple	All parts
Alnus rubra Bong.	red alder	Coast Ranges
Arbutus menziesii Pursh	Pacific madrone	All parts
Castanopsis chrysophylla Dougl. A. DC.	golden chinkapin	Coast and Cascade Ranges
Fraxinus latifolia Benth.	Oregon ash	Interior valleys and Coast Ranges
Lithocarpus densiflorus (Hook. & Arn.) Rehd.	tanoak	Coast Ranges and Cow Creek
Populus trichocarpa Torr. & Gray	black cottonwood	Moist sites
Quercus chrysolepis Liebm.	canyon live oak	Interior valleys and Coast Ranges
Quercus garryana Dougl.	Oregon white oak	Interior valleys
Quercus kelloggii Newb.	California black oak	Interior valleys
Umbellularia californica (Hook. & Arn.) Nutt.	California-laurel (Oregon myrtle)	Coast Ranges

Inventory Procedures

This report of Douglas County's forest resources combines data from four National Forest inventories, four BLM inventories, and an inventory of the private, State, county, and municipal lands conducted by the Forest Resources Evaluation Project of the Pacific Northwest Forest and Range Experiment Station. All of the BLM inventories and three of the National Forest inventories have been updated to 1973 to account for cutting, reforestation, growth, and mortality since the dates of inventory. A summary of the various inventories follows:

On the Willamette National Forest, nonforest, noncommercial forest, and clearcut areas were mapped and the field sample restricted to commercial forest land, exclusive of clearcuts. Inventory data on clearcuts came from forest records based on plantation and compartment examinations.

For the Siuslaw National Forest inventory, three 1/5-acre plots were established at each field plot location. On all other National Forest and BLM inventories, the field plot used was a cluster of 10 variable-radius points sampling an acre. Seedlings and saplings were sampled on small fixed-radius plots located at each of the 10 points.

Inventory	Number of plots	Field plot grid intensity	Inventory date	Updated to
		(Miles)		
Umpqua National Forest	459	1.7	1968	1973
Siuslaw National Forest	29	1.7	1963	1973
Willamette National Forest	23	1.7	1971	--
Rogue River National Forest	34	1.7	1967	1973
Roseburg BLM District	428	1.2	1969	1973
Coos Bay BLM District	130	1.2	1968	1973
Eugene BLM District	19	1.2	1968	1973
Medford BLM District	39	1.7	1966	1973
Private, State, county, and municipal lands:				
Timber zone	141	3.4	1973	--
Agricultural zone	27	6.8	1973	--

NATIONAL FOREST AND BLM INVENTORIES

The National Forest and BLM inventories were all simple systematic samples with field plots distributed on a square grid. For all except the Willamette National Forest inventory, volume, area, and growth data were expanded from field plots, with each plot having equal weight.

For all but the Willamette National Forest inventory, growth and mortality were updated by stand projection (Larson and Goforth 1970). In addition, all plots cut since inventory were identified and assigned new area classifications based on data furnished by the BLM and the U.S. Forest Service. Treatment prescriptions were based on inventory data, except where better data were furnished by the agencies.

THE INVENTORY OF PRIVATE AND OTHER PUBLIC LANDS

The sampling design used was double sampling for stratification (Cochran 1963). Classifications on about 3,500 photo points were used to divide the inventory unit into a series of strata based on: (1) owner group; (2) major land class (commercial forest, noncommercial forest, and nonforest); and (3) stand volume class. In addition, the entire inventory unit was divided into two zones: the timber zone and the agricultural zone. Permanent field plots were remeasured on a 3.4-mile grid in the timber zone and on a 6.8-mile grid in the agricultural zone. Field plot weights were calculated separately for each owner-land class-stand volume stratum in each zone. To provide at least two field plots for each stratum, 14 supplemental plots were added.

The same 10-point field plot was used in this inventory that had been used on the National Forest and BLM inventories. However, unlike those inventories, most of these field plots were originally established earlier in 1962 and were remeasured for this inventory. Growth and mortality estimates were made by comparing old and new tallies on remeasured plots and from increment cores and ocular mortality estimates on supplemental plots.

At all field plot locations and at 60 other randomly selected locations, we identified and sampled 10-acre management units that represented single forest conditions. These data were then used to identify physical opportunities for silvicultural treatment.

Definition of Terms

Land Area

Total land area is that reported by the Bureau of the Census and includes dry land and land temporarily or partially covered by water (such as marshes, swamps, and river flood plains), streams, sloughs, and canals less than 1/8-mile wide, and lakes, reservoirs, and ponds less than 40 acres in area.

Forest land is at least 10 percent stocked by trees of any size or formerly having such tree cover, and not currently developed for nonforest use. Minimum area of forest land recognized is 1 acre.

Nonforest land has never supported forests or was formerly forested and is currently developed for nonforest uses. Included are areas used for agricultural crops, improved pasture, residential areas, city parks, improved roads, and operating railroads and their right-of-way clearings, powerline and pipeline clearings, and 1- to 40-acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and other nonforest strips must be more than 120 feet wide, and clearings, etc., more than 1 acre in size, to qualify as nonforest land.

Forest-land Classes

Commercial forest land is capable of producing 20 cubic feet per acre per year of industrial wood and not withdrawn from timber utilization.

Noncommercial forest land is land incapable of yielding crops of industrial wood because of adverse site conditions, or is productive public forest land withdrawn from commercial timber use through statute or administrative regulation.

Productive-reserved forest land is public land withdrawn from timber utilization through statute, ordinance, or administrative order but which otherwise qualifies as commercial forest land.

Unproductive forest land is land incapable of yielding crops of industrial wood products because of adverse site conditions such as sterile soils, poor drainage, high elevation, steepness, and rockiness.

Forest Types

Stands with 50 percent or more stocking in live conifer trees are called softwood types. Stands with a majority of stocking in live hardwood trees are classed as hardwood types. Within these two type groups, the individual forest type is determined by plurality of stocking by species of live softwood or hardwood trees.

Tree Classes

Growing Stock

Growing stock trees are live trees of commercial species which meet the minimum merchantability standards for sawtimber, poletimber, or seedling and sapling trees.

Sawtimber trees are growing stock trees and are at least 9.0 inches in d.b.h. if they are softwoods and at least 11.0 inches in d.b.h. if they are hardwoods. At least 25 percent of the board-foot volume in any sawtimber tree must be free from defect. Softwood trees must contain at least one 12-foot saw log with a top diameter of not less than 6 inches inside the bark; hardwood trees must contain at least one 8-foot saw log with a top diameter of not less than 8 inches inside the bark.

Poletimber trees are growing stock trees 5.0 to 8.9 inches in d.b.h. with a cubic-foot volume of wood that is at least 50 percent free from defect. They are free from any disease, defect, or deformity which is likely to prevent their becoming sawtimber trees.

Sapling and seedling trees are growing stock trees that are less than 5.0 inches in d.b.h. and have no disease, defects, or deformities which are likely to prevent their becoming growing stock poletimber trees.

Nongrowing Stock

Cull trees are noncommercial species or commercial species which are too defective or which are unlikely to become growing stock trees due to deformity, disease, low vigor, etc.

Sound cull trees are noncommercial species or commercial species with excessive defect due to form, roughness, etc.

Rotten cull trees have excessive defect due primarily to rot.

Mortality trees are commercial species which have died from natural causes within a specified period and which were growing stock trees at the time of death.

Salvable dead trees are standing or down trees of commercial species, 9.0 inches or more in diameter, containing 25 percent or more of sound volume and at least one merchantable 16-foot log if a softwood or one merchantable 8-foot log if a hardwood.

Stand-size Classes

Sawtimber stands are at least 10 percent stocked with growing stock trees, with half or more of this stocking in sawtimber and poletimber trees and with sawtimber stocking equal to or greater than poletimber stocking. In *large sawtimber stands*, the majority of the sawtimber stocking is in trees 21.0 inches and larger at breast height. In *small sawtimber stands*, the majority of the sawtimber stocking is in trees from 9.0 to 20.9 inches at breast height.

Poletimber stands are at least 10 percent stocked with growing stock trees, with half or more of this stocking in sawtimber and poletimber trees, and with poletimber stocking exceeding sawtimber stocking.

Sapling and seedlings stands are at least 10 percent stocked with growing stock trees, with more than half of this stocking in saplings, seedlings, or both.

Nonstocked areas of commercial forest land are less than 10 percent stocked with growing stock trees.

Timber Volume

Live Sawtimber

Net volume of live sawtimber trees of commercial species is measured in board feet. Net volume equals gross volume less deduction for rot, sweep, crook, and other defects that affect use for lumber.

Scribner rule is the common board-foot log rule used locally in determining volume of sawtimber. Scribner volume is measured in terms of 32-foot logs.

International 1/4-inch rule is the standard board-foot log rule adopted nationally by the Forest Service for the presentation of Forest Survey volume statistics.

Saw-log portion is the bole of sawtimber trees between the stump and the saw-log top.

Upper stem portion includes the bole of sawtimber trees above the saw-log top of 7.0 inches outside bark for softwoods and 8.0 inches outside for hardwoods to a minimum top diameter of 4.0 inches outside bark; or to the point where the central stem breaks into limbs.

Growing Stock

Net volume in cubic feet of live sawtimber trees and live poletimber trees from stump to a minimum 4.0-inch top (of central stem) outside bark is measured. Net volume equals gross volume less deduction for rot and missing bole sections.

All Timber

Net volume in cubic feet of live growing stock poletimber and sawtimber trees and salvable dead sawtimber trees of commercial species; and gross volume of cull trees of all species. Volume is measured from stump to a minimum 4.0-inch top outside bark.

Industrial Wood

All roundwood products except fuelwood are included.

Net Annual Growth

The net increase in volume of trees during a specified year is included. Components of net annual growth include: (a) the increment in net volume of trees at the beginning of the specified year surviving to the year's end plus (b) the net volume of trees reaching the size class during the year minus (c) the net volume of trees that died during the year minus (d) the net volume of trees that became culls during the year.

Ownership Classes

National Forest lands are Federal lands which have been designated by Executive Order or statute as National Forests or purchase units and other lands under the administration of the Forest Service, including experimental areas and Bankhead-Jones title III lands.

Other public lands are Federal lands other than National Forests or lands administered by the Bureau of Land Management and lands owned by States, counties, and local public agencies or leased by these governmental units for more than 50 years.

Forest industry lands are owned by companies or individuals operating wood-using plants or whose primary operation is growing wood for industrial use.

Other private lands include all private lands except those classed as forest industry lands.

Treatment opportunities are physical opportunities to manipulate either the growing stock or competing vegetation to increase wood production.

A *regeneration cut* is the harvest cut that immediately precedes regeneration of the stand. Stands which exceed the age of culmination of mean annual cubic-foot increment are usually considered candidates for regeneration cutting.

A *thinning* is an intermediate cutting in an immature stand to increase growth, increase average tree size, capture potential mortality, and increase total net yield.

A *commercial thinning* is one which produces enough salable products to cover the cost of operation. Stands with a mean diameter of at least 8 inches and with stocking that exceeds the maximum level[5] are assumed to be eligible for commercial thinning.

A *precommercial thinning* is a thinning in a stand too young to produce salable products. Stands between 10 and 30 feet high which exceed the maximum stocking level (see footnote 2) are considered candidates for precommercial thinning.

A *cleaning* or *release* is a treatment (usually herbicidal spray) in a seedling or sapling stand to remove undesirable brush, grass, or hardwood competition.

Site preparation is the chemical or mechanical treatment of a site to remove inhibiting material prior to planting.

Planting is the establishment of a forest by setting out seedlings. To qualify for fill-in planting in partially stocked stands, openings must be at least 40 feet in diameter and free of trees over 4 feet in height.

Stand conversion is an operation performed on stands which lack stocking of trees that are presently or potentially salable.

---

[5] David Bruce and Donald L. Reukema. Derivation of stocking guides for Douglas-fir and hemlock spruce. Unpublished manuscript on file at Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Literature Cited

Beuter, John H., K. Norman Johnson, and H. Lynn Scheurman.
1976. Timber for Oregon's tomorrow. Oreg. State Univ. For. Res. Lab. Res. Bull. 19, 111 p., illus. Corvallis.

Cochran, W. G.
1963. Sampling techniques. 2d ed. 413 p. John Wiley & Sons, Inc., New York.

Darr, David R. and Roger D. Fight.
1974. Douglas County, Oregon: Potential economic impacts of a changing timber resource base. USDA For. Serv. Res. Pap. PNW-179, 41 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Larson, Robert W. and Marcus H. Goforth.
1970. TRAS, a computer program for the projection of timber volume. U.S. Dep. Agric. Agric. Handb. 377, 24 p., illus.

Little, Elbert L., Jr.
1953. Check list of native and naturalized trees of the United States (including Alaska). U.S. Dep. Agric. Agric. Handb. 41, 472 p.

MacLean, Colin D., and Charles L. Bolsinger.
1973. Estimating productivity on sites with a low stocking capacity. USDA For. Serv. Res. Pap. PNW-152, 18 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

McArdle, Richard E., Walter H. Meyer, and Donald Bruce.
1961. The yield of Douglas-fir in the Pacific Northwest. U.S. Dep. Agric. Tech. Bull. 201 (rev.), 74 p., illus.

Miller, Richard E., and Richard L. Williamson.
1974. Dominant Douglas-fir respond to fertilizing and thinning in southwest Oregon. USDA For. Serv. Res. Note PNW-216, 8 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

U.S. Department of Agriculture, Forest Service.
1934. Forest statistics for Douglas County. USDA For. Serv. Pac. Northwest For. and Range Exp. Stn., 6 p., illus. Portland, Oreg.

U.S. Department of Agriculture, Forest Service.
1973. The outlook for timber in the United States. USDA For. Serv. For. Resour. Rep. FRR-20, 367 p., illus.

Wall, Brian R.
1972. Log production in Washington and Oregon--An historical perspective. USDA For. Serv. Resour. Bull. PNW-42, 89 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

☆ U. S. GOVERNMENT PRINTING OFFICE: 1976—697-538/99

MacLean, Colin D.
1976. Timber resources of Douglas County, Oregon. USDA For. Serv. Resour. Bull. PNW-66, 42 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report summarizes a 1973 timber resource inventory of Douglas County, Oregon. Detailed tables of forest area, timber volume, growth, mortality, and cut are presented. A discussion of the present resource situation highlights the condition of cutover lands and the opportunities for silvicultural treatment.

KEYWORDS: Forest surveys, statistics (forest), resources (timber), southwest Oregon, Douglas County.

MacLean, Colin D.
1976. Timber resources of Douglas County, Oregon. USDA For. Serv. Resour. Bull. PNW-66, 42 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report summarizes a 1973 timber resource inventory of Douglas County, Oregon. Detailed tables of forest area, timber volume, growth, mortality, and cut are presented. A discussion of the present resource situation highlights the condition of cutover lands and the opportunities for silvicultural treatment.

KEYWORDS: Forest surveys, statistics (forest), resources (timber), southwest Oregon, Douglas County.

MacLean, Colin D.
1976. Timber resources of Douglas County, Oregon. USDA For. Serv. Resour. Bull. PNW-66, 42 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report summarizes a 1973 timber resource inventory of Douglas County, Oregon. Detailed tables of forest area, timber volume, growth, mortality, and cut are presented. A discussion of the present resource situation highlights the condition of cutover lands and the opportunities for silvicultural treatment.

KEYWORDS: Forest surveys, statistics (forest), resources (timber), southwest Oregon, Douglas County.

MacLean, Colin D.
1976. Timber resources of Douglas County, Oregon. USDA For. Serv. Resour. Bull. PNW-66, 42 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report summarizes a 1973 timber resource inventory of Douglas County, Oregon. Detailed tables of forest area, timber volume, growth, mortality, and cut are presented. A discussion of the present resource situation highlights the condition of cutover lands and the opportunities for silvicultural treatment.

KEYWORDS: Forest surveys, statistics (forest), resources (timber), southwest Oregon, Douglas County.

L

Be
ar

Co

Da

L
G

I

N
I

I

The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Developing and evaluating alternative methods and levels of resource management.
3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research are made available promptly. Project headquarters are at:

Fairbanks, Alaska
Juneau, Alaska
Bend, Oregon
Corvallis, Oregon
La Grande, Oregon
Portland, Oregon
Olympia, Washington
Seattle, Washington
Wenatchee, Washington

Mailing address: *Pacific Northwest Forest and Range*
Experiment Station
P.O. Box 3141
Portland, Oregon 97208

The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

The U.S. Department of Agriculture is an Equal Opportunity Employer. Applicants for all Department programs will be given equal consideration without regard to race, color, sex or national origin.

80·PNW 67

USDA Forest Service Resource Bulletin PNW-67
1976

TIMBER SUPPLY AND USE in the Haines-Skagway Area, Alaska

CLEMSON UNIVERSITY LIBRARY
FEB 17 1977
SCI., TECH. & AGR. DIV.

Vernon J. LaBau
O. Keith Hutchison

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
U.S. Department of Agriculture Forest Service Portland, Oregon

Acknowledgments

The forest inventory reported here was accomplished by joint efforts of the Forestry Sciences Laboratory of the Forest Service, U.S. Department of Agriculture at Juneau, Alaska, and the State of Alaska Department of Natural Resources, through the State Forester's office at Anchorage. Without the interest and aid of the State Forester and his staff, this inventory would not have been made.

Metric Conversions

1 acre = 0.4047 hectare
1 hectare = 2.47 acres
1 cubic foot = 0.0283 cubic meter
1 cubic meter = 35.3145 cubic feet
1 cubic foot per acre = 0.06997 cubic meter per hectare
1 cubic meter per hectare = 14.29 cubic feet per acre
20 cubic feet per acre = 1.3994 cubic meter per hectare
1 square foot basal area per acre = 0.2296 square meter per hectare
1 square meter per hectare = 4.356 square feet per acre

Cover photo: Logged area is old-growth Sitka spruce type on the glacial moraine in front of Davidson Glacier near Haines, Alaska.

TIMBER SUPPLY AND USE
IN THE HAINES-SKAGWAY AREA, ALASKA

Reference Abstract

LaBau, Vernon J., and O. Keith Hutchison
1976. Timber supply and use in the Haines-Skagway area, Alaska. USDA For. Serv. Resour. Bull. PNW-67, 44 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Discusses the results of a 1965 forest inventory of 449,300 acres in the Haines-Skagway area. Selected references are used to describe the economy of the area historically and currently. Interpretations and assessments of the timber resource in the continuing economy are made.

KEYWORDS: Forest surveys (Alaska), resources (forest), timber marketing.

RESEARCH SUMMARY

Resource Bulletin PNW-67

1976

An area of 449,300 acres at the head of Lynn Canal, referred to in this report as the Haines-Skagway area, has 193,600 acres of forest land of which 111,000 acres is of commercial quality. The nonforest area, 255,700 acres, is mostly gravel bars along the rivers, muskeg, brushland along the streams, and alpine vegetation above timberline.

The State of Alaska owns 75.6 percent of the area studied, including 84,000 acres of commercial forest land. The remaining 27,000 acres of commercial forest land is in private, municipal, or Indian corporation ownerships. Of 256,694 acres of State land that have been patented and tentatively approved, 107,119 acres have been classified. At this time, it appears that approximately 75 percent of the commercial forest land in the area will be classified "resource management."

Contents

Page

INTRODUCTION 1

LAND AND FOREST AREA 5

FOREST LAND OWNERSHIP 6

FOREST TYPES. 8

STAND-SIZE CLASSES 8

FOREST VOLUME 9
- Sawtimber Volume 9
- Growing-Stock Volume 10

QUALITY OF SAWTIMBER 10

CURRENT GROWTH 11
- Growth Estimates 11

TIMBER LOSSES AND RISKS 11

PRODUCTIVITY 13
- Stocking Condition 13
- Volume Classes 13
- Site 13

ALLOWABLE CUT 14
- Timber Processing and Marketing 15

DEFINITION OF TERMS 18
- Land Use Classes 18
- Forest Types 19
- Tree and Stand Classes 19
- Volume Classes 20
- Log Grades 20
- Abbreviations Used 20
- Stocking Classes 21
- Volume Measurements 21
- Allowable Cut 21
- Reliability of Estimates 22

LITERATURE CITED 22

TABLES OF RELIABILITY 25

DETAILED TABLES OF ESTIMATES 26

Preface

Forest Survey, authorized by the McSweeney-McNary Forest Research Act of 1928, as amended and supplemented, is a nationwide project of the Forest Service. The Act was amended in August 1953 to include territories and possessions. Forest inventory work began in Alaska in 1954. The purpose of the survey is to periodically inventory the area and condition of forest lands and the volume of timber on them, to determine rates of forest growth and depletion, to estimate present consumption of timber products and probable future trends in timber requirements, and to analyze and distribute information needed in the formulation of forest policies and programs.

This report summarizes the results of the first intensive forest inventory of the Haines-Skagway area and adjacent drainages.

The survey was based on a study of aerial photographs, followed by field measurements to check the accuracy of the photo interpretation and to obtain supplemental tree measurements. The sampling technique was designed to determine the commercial forest area within ±3 percent per million acres and the timber volume within ±5 percent per billion cubic feet of growing stock.

Vertical aerial photographs at 1:12,000 scale of the area to be studied were provided by the State of Alaska, Division of Lands. Systematically selected plots were interpreted on the photos, and a sample of these plots was sent to the field for examination. Three 1/5-acre plots were measured at each field location.

The hemlock-spruce type accounts for 84.6 percent of the commercial forest land and for 93 percent of the sawtimber volume. A cottonwood type found on the flood plains and gravel bars accounts for 13.8 percent of the commercial forest land and 6 percent of the sawtimber volume. A birch type accounts for the remaining area and volume.

The total net volume of sawtimber is 2,887 million board feet. The stands average 29,800 board feet per acre (gross) and 26,000 net. Of the net volume, 47 percent is Sitka spruce (*Picea sitchensis* (Bong.) Carr.) and 42.7 percent western hemlock (*Tsuga heterophylla* (Raf.) Sarg.). Of the gross volume, however, 43.9 percent is Sitka spruce and 46.0 percent western hemlock.

Gross annual growth averaged 172 cubic feet per acre for the young-growth stands measured. Growth was not measured on old-growth stands; instead, increment in these stands was assumed to be offset by losses from decay, windthrow, and other causes. For the total commercial forest area, the gross annual growth averaged 56.19 cubic feet per acre, with a net average of 36.76 cubic feet. Mortality which is deducted from gross growth to obtain net growth was 78.6 percent Sitka spruce and 19.5 western hemlock. A predominance of mortality seems to support a theory that the spruce stands of this region are generally approaching climax conditions with the spruce giving way to hemlock stocking.

Haines has two sawmills and is an important port for export of logs and cants. Logs are exported from private land. The log volume supplied from State land from 1961 through 1973 averages 19.9 million board feet annually. If all present State forest land of the Haines-Skagway area remains available for timber production, the present average log supply should be sustained.

Introduction

At the head of Lynn Canal, bounded by British Columbia on the north and west, the North Tongass National Forest on the south and east, and Glacial Bay National Monument on the southwest, is an extensive area of former public domain now largely in State ownership (fig. 1). The main drainage of this

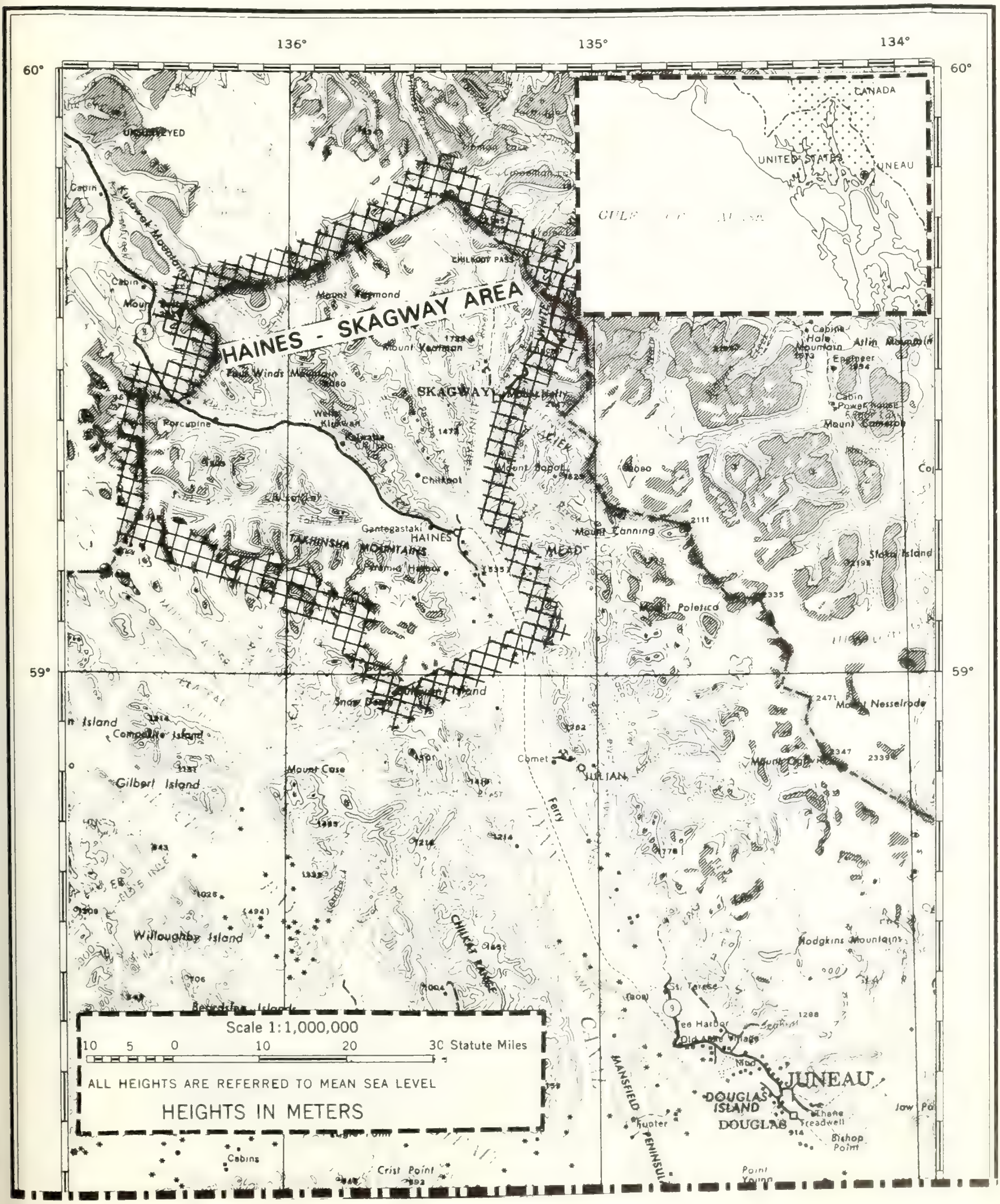


Figure 1.--The Haines-Skagway area.

area is southward into Lynn Canal which is a natural body of water affected by the Pacific Ocean tides. The Klehini, Kelsall, Chilkat (fig. 2), Chilkoot (fig. 3), Skagway, and Taiya Rivers are the most important streams; but none are navigable except by small boats. All are glacial-fed streams, and the water level fluctuates considerably.

This region is the home of the well-known Chilkat Indians, members of the Tlingit tribe. Native villages included Klukwan, Chilkat, Chilkoot, and Yindastuki. Russian, American, and other traders were familiar with this area long before settlements began at Haines, Dyea, and Skagway.

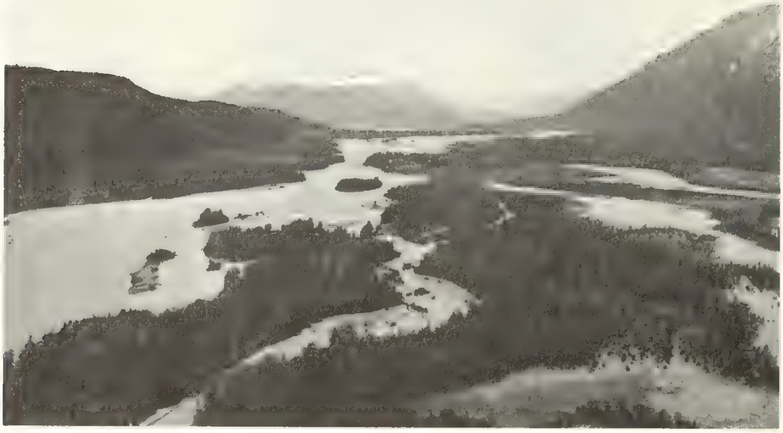


Figure 2.--The Chilkat River valley as seen from about Mile 10 on the Haines Highway.

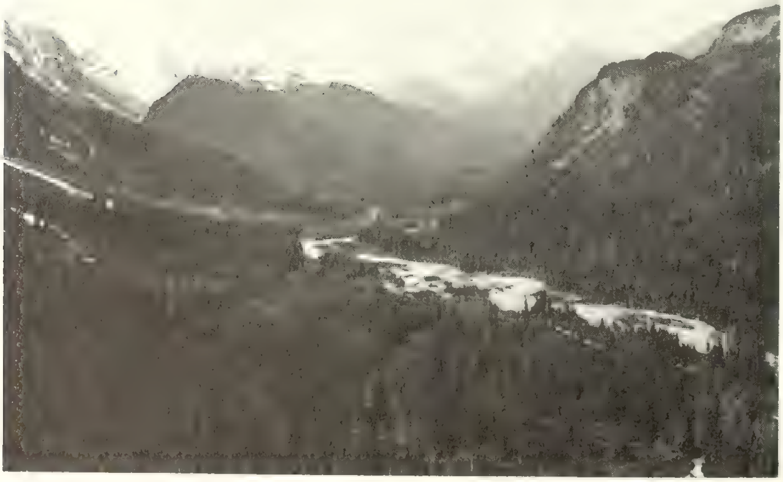


Figure 3.--A view up the Chilkoot River valley.

Haines began in 1881 as a project of the Presbyterian Church. Reverend and Mrs. Eugene S. Willard were sent to establish a church and school known as "Haines House". This early settlement was named after Mrs. F. E. Haines who helped finance the project (Cooley 1953). About 1890, John Dalton constructed a 400-mile trail from Haines to Fort Selkirk on the Yukon River. The trail followed the Chilkat and Klehini Rivers to Chilkat Pass and was used to move freight supplies and livestock. Dyea was established a few years later as a station on the Chilkoot trail to the Klondike. In 1898, Skagway began as a tent city and became the staging area for entry to the Klondike goldfields by a shorter route over White Pass.

After the gold rush, Haines, Port Chilkoot and Skagway survived as the only business settlements in the area (fig. 4). These towns have histories of sporadic growth and recessions. Fort William H. Seward, an army post, was established adjacent to Haines in 1904 and was comprised of 85 permanent buildings with 400 officers and men (Cooley 1953). Haines developed with an economy built on retail trade and services. Both Haines and Skagway experienced a recession, however, as mining declined and lost all importance by 1920. Haines flourished again during World War II after a highway was built to connect with the newly constructed Alaska Highway. Recession hit again in 1946, however, as the war ended and the army post was closed. The economy was left with two small canneries, one small sawmill, and a few truck gardens. In 1950 the population was 645, and employment ranged from a peak of 94 in August to a low of 15 in January. The army post was sold to private enterprise and was renamed Port Chilkoot. About 1970, Port Chilkoot was annexed to become a part of the city of Haines.[1]

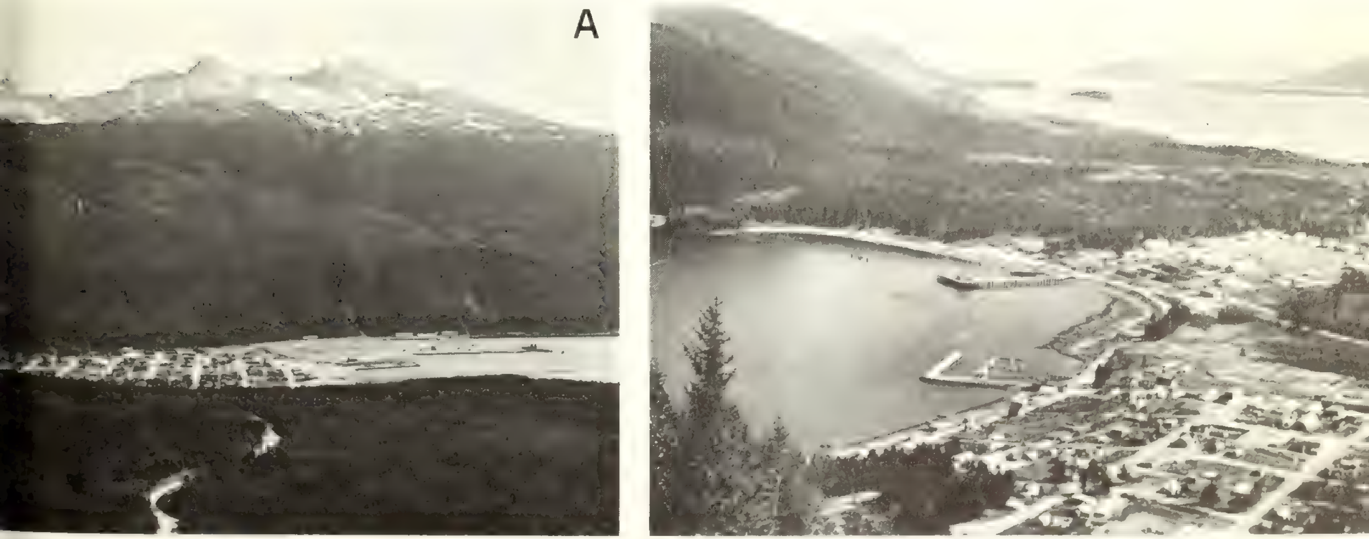


Figure 4.--A, Skagway; B, Haines and Port Chilkoot, Alaska (Port Chilkoot was annexed to Haines about 1970). (Photo, courtesy Tom Wade, State of Alaska)

---

[1] Source: State of Alaska, Department of Community and Regional Affairs.

Today a narrow gage railroad through the White Pass connects Skagway with Whitehorse in the Yukon. Haines is connected by highway to Canada and west Alaska. A marine highway, connecting Skagway and Haines to the rest of southeast Alaska, has brought a great increase in tourism and travel to this area. As signs of industrial development begin to show in British Columbia, the Yukon, and Alaska, these communities show promise of becoming important export points for wood and mineral products.

In 1954, a preliminary survey of forests in this area indicated a sufficient timber volume for significant sustained industrial development. At that time, these stands were largely in the public domain managed by the Bureau of Land Management, U.S. Department of the Interior. After Alaska became a State, most of the commercial forest land of this area was selected for State ownership. In 1965, the State of Alaska Division of Lands and the U.S. Forest Service undertook a new and more intensive inventory of the forests of this region (fig. 5). That inventory is the basis for this report.

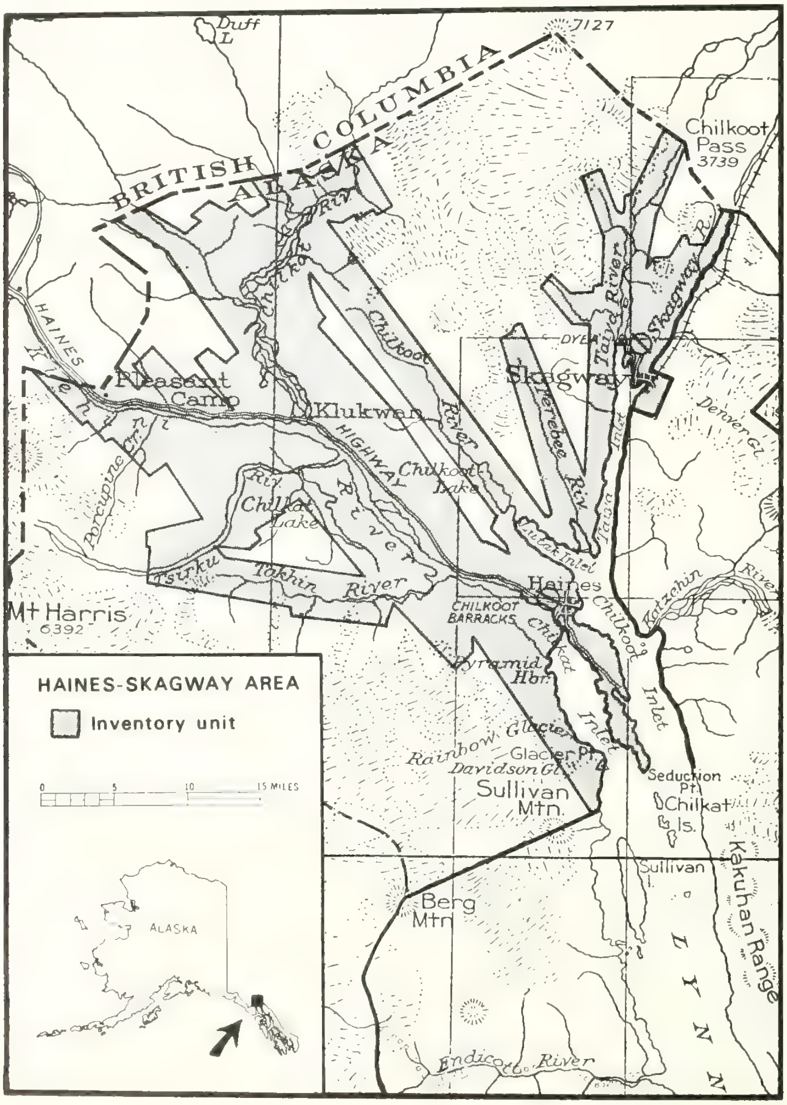


Figure 5.--The shaded portion indicates the area covered by aerial photographs; this includes most of the commercial forest land of the Haines-Skagway area.

Land and Forest Area

The total area of the Haines-Skagway region has been estimated to be 912,400 acres. The total area included in this study was 449,300 acres. This area was selected because maps, aerial photographs, and local knowledge showed that practically all the available commercial forest land was within this area. A systematic study of the aerial photographs followed by a field check showed the total forest area to be 193,600 acres, of which 111,000 acres (fig. 6) were of commercial quality.[2] A subsequent study was made to determine the amount of forest land outside the study area but within the 912,400-acre region. About 27,500 acres of forest land are estimated to be in this "outside area," of which about 12,000 acres are of commercial quality. If this estimate of "outside" forest land is included in the totals, there are 123,000 acres of commercial forest in a total forest area of 221,100 acres.

The nonforest area of the study unit, 255,700 acres, is mostly gravel bars along the rivers, muskeg, brushland along the streams, and alpine vegetation above timberline. Little of the area is used for commercial and agricultural purposes, although Haines is noted for its strawberries. About 5,200 acres of the nonforest area are water in lakes and streams. An additional 435,600 acres of high-elevation, nonforest land in the "outside" area are not included in this study. The variety of vegetative types, beautiful lakes and streams, rugged mountains, and pleasing climate combines to make this area much in demand for recreation. Development for recreational use is already well started, and much coordinated management will be required to keep various land uses from conflicting.

---

[2] For definitions of terms used in this report, see page 18.

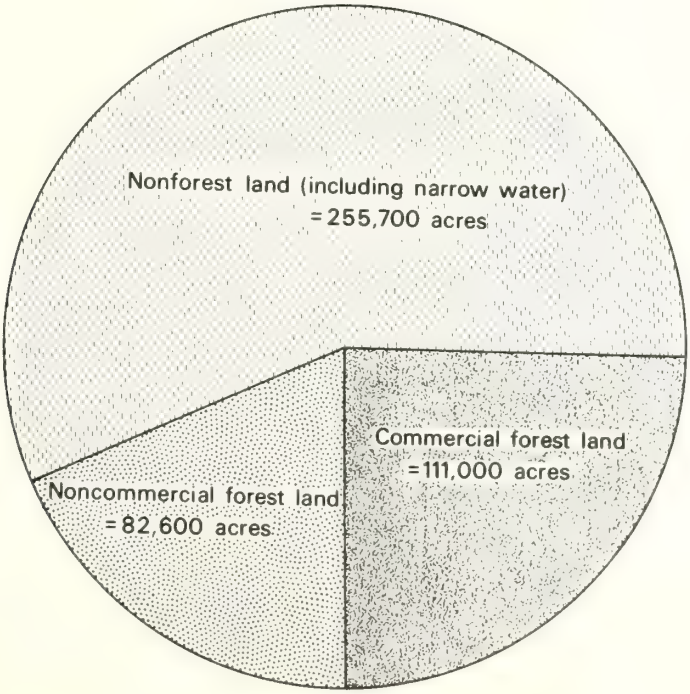


Figure 6.--Of the 449,300 acres studied, roughly 25 percent is commercial forest land. An additional 18 percent is forest land of noncommercial quality.

Forest Land Ownership

The inventory did not include a study of ownership. However, based on forest type maps prepared by the Alaska Division of Lands, the State owns 75.6 percent of the area studied, of which 84,000 acres is commercial forest land. The remaining 27,000 acres of commercial forest land are in private, municipal, or Indian corporation ownerships. None is in the Tongass National Forest which joins the study area on the south.

Further analysis by the State Department of Natural Resources, Division of Lands, shows that of the approximately 1 million acres of land comprising the Haines-Skagway area (fig. 7) the State has selected 415,000 acres under the Alaska Statehood Act of 1958. As of October 1974, the State had received patent to 169,178 acres and tentative approval for patent to an additional 87,516 acres. Since there are no Native village withdrawals[3] or other withdrawals in the area, the State expects patent will be received to all present and future land selections. However, it should be noted that the village of Klukwan elected to obtain surface and subsurface rights to their revoked reservation.

Through the State's land planning process, State lands are placed in one of several classifications. Certain classifications, such as "resource management" and "public recreation," are used for lands to be retained in State ownership. Other classifications, such as "industrial," "private recreation," "residential," and "utility," are used for lands planned to be leased or sold. Of the 256,694 acres of patented and tentatively approved lands, 107,119 acres have been classified:

	Acres
Resource management	54,100
Timber	48,577
Utility	35
Public recreation	2,131
Reserved use	73
Residential	5
Private recreation	644
Mineral	153
Industrial	1,401
Total	107,119

Of the lands patented to the State, only 252.3 acres have been placed in other ownerships through maturing land sale contracts or transfers to local government. In 1975 there were 2,085 acres in disposal classifications, some of which will pass from State ownership when existing contracts mature. Additional lands will ultimately be transferred to local governments.

Most of the State-selected lands, however, will ultimately be classified "resource management." Resource management lands are defined by State regulation as lands containing an association of surface and subsurface resources which are especially suited to multiple-use management. State forest lands are logically placed within this classification. These lands will be retained in State (public) ownership and managed for resource use and development. Lands classified "resource management" may be leased for purposes consistent with the public interest but may not be sold or transferred to local government. Lands needed by communities for future growth and development as well as for long-range needs of public recreation will preclude all commercial forests on such lands from being managed for timber production.

At this time, it appears that approximately 75 percent of the commercial forest land in the area will be included in the resource management classification.

---

[3] The Alaska Native Claims Settlement Act, 1971, P.L. 92-746 (43 U.S.C. 1601).

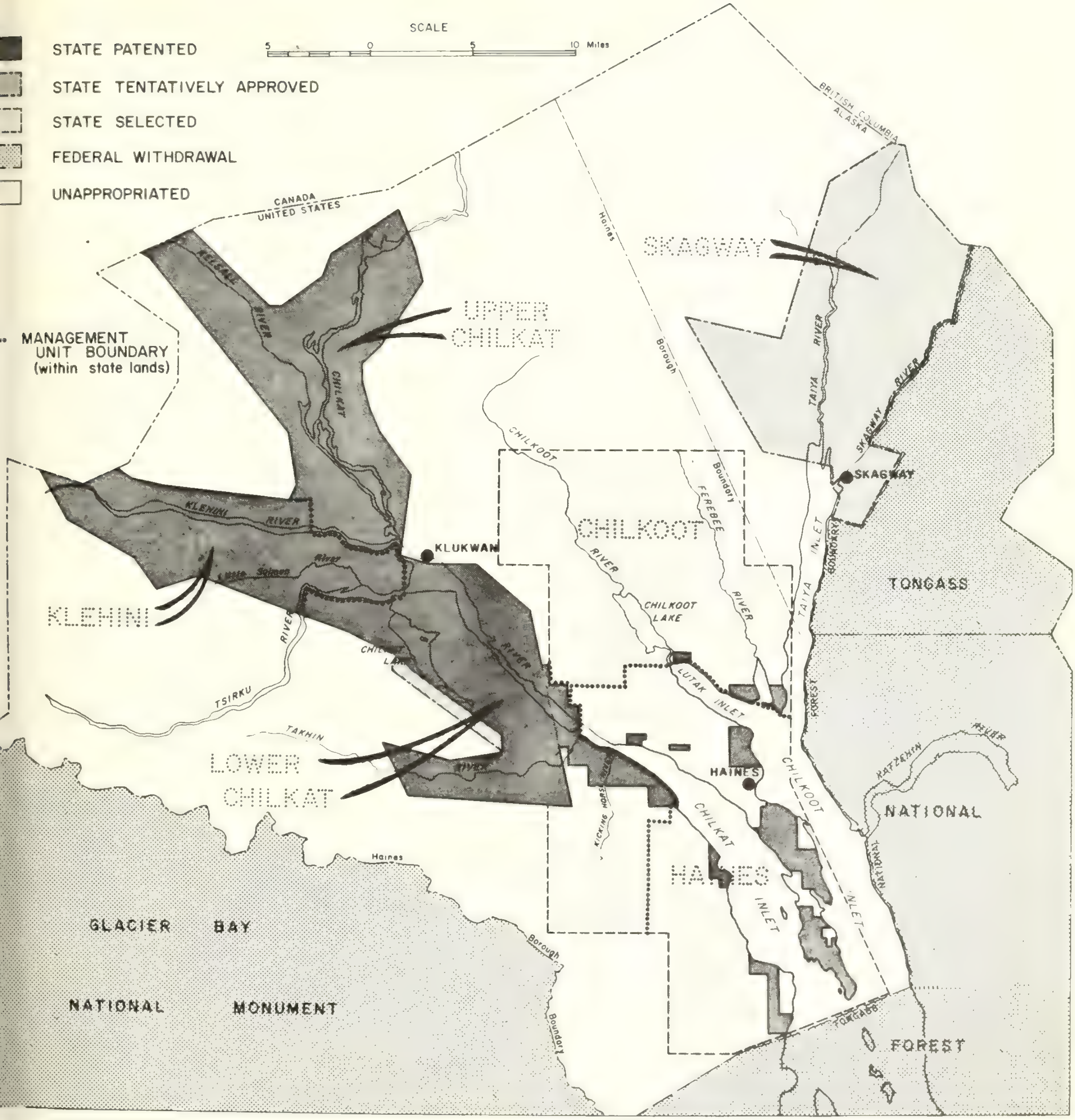


Figure 7.--Haines-Skagway ownership status and management units.

Forest Types

Several forest types can be recognized in the Haines-Skagway area, but only two are of commercial importance, the hemlock-spruce and the cottonwood types (table 6). The survey also measured the birch type, but this type is found on only 1.6 percent of the commercial forest area. The birch type and some less important types not included in our tables, such as lodgepole pine (*Pinus contorta* var. *latifolia* Engelm.) and aspen (*Populus tremuloides* Michx.), represent the southern limits of Yukon and British Columbia forests. These types are characteristic of drier climates than the coastal zone where spruce and hemlock dominate.

The hemlock-spruce type, comprising 93,900 acres, is 95-percent sawtimber. These stands are much in demand for saw logs and pulpwood. This type accounts for 84.6 percent of all commercial forest land and 93 percent of the sawtimber volume. Almost all the commercial stands occur below 2,000-foot elevation. Most of these stands are considered accessible by present logging methods.

Regeneration of these stands after logging is not expected to present serious problems; regeneration is being continuously monitored by the State Forester to recognize and correct any problem areas. A comparison of tables 25 and 28 indicates that over 9,000 acres of commercial forest land were cut over between 1964 and 1973 on State and private land. Cutover areas with less than 40-percent stocking 3 years after cutting would be inadequately stocked. Thus far, all cutover areas have been more than 46 percent stocked, with some stocked at least 90 percent.

The cottonwood type, comprising 15,300 acres, is found on the flood plains and gravel bars bordering the streams. This type accounts for 13.8 percent of all commercial forest land and 6 percent of the sawtimber volume. Most of the cottonwood type is in sawtimber stands. These stands appear thrifty and of good quality, but logging experience has shown many of them to be overmature and quite defective. Some black cottonwood (*Populus trichocarpa* Torr. & Gray) has been logged, but experience with management of these stands is too limited to show what problems may be encountered in regeneration. In other regions, cottonwood has been slow to regenerate. The cutover areas often revert to brush and weeds.

The birch type, accounting for 1.6 percent of the commercial forest land, occurs in scattered, spotty locations and is not expected to develop much commercial importance. Some specialty and novelty uses may develop for local birch (*Betula papyrifera* var. *commutata* (Reg.) Fern.).

Stand-Size Classes

Ninety-four percent of the commercial forest area is now supporting enough timber volume to be classed as sawtimber (table 2). The minimum volume in this classification is 8,000 board feet (International 1/4-inch rule).[4/] Sawtimber stands were further divided into old growth and young growth. Old-growth (trees averaging more than 150 years old) sawtimber stands accounted for 67.3 percent of the area, and young-growth sawtimber stands, 26.7 percent. For management purposes it may be desirable to harvest the old-growth stands as early as possible. On the other hand, if markets are not suitable, some stands can be held for several years without serious loss.

Poletimber stands comprise only 3.5 percent of the commercial forest area, and seedling and sapling stands

---

[4/] Throughout this report, unless otherwise stated, values given in board feet are based on the International 1/4-inch rule.

comprise only 2.5 percent, indicating an imbalance for easy management. For management based on strict area-control, one-fourth of the area should be in each stand-size class (not including the nonstocked class). Of course, other forms of management may be used, requiring some degree of imbalance by stand-size class.

Forest Volume

SAWTIMBER VOLUME

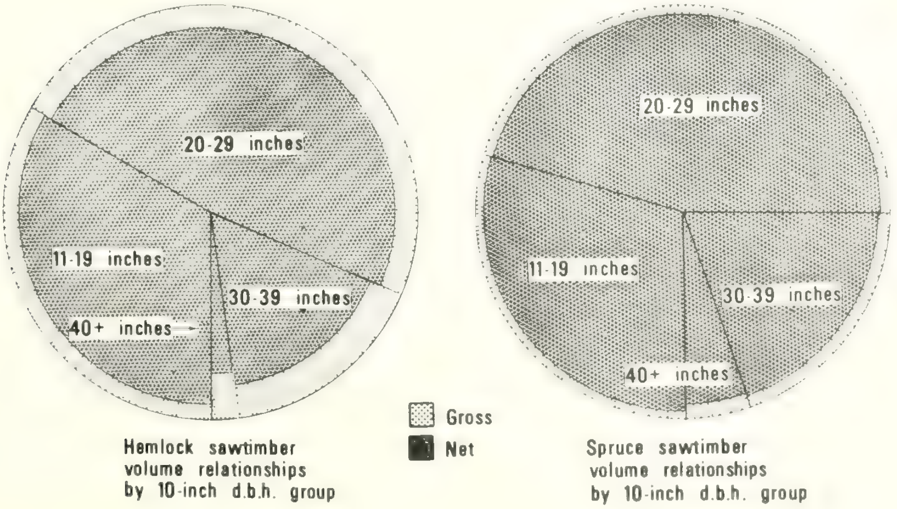
Commercial forests in the Haines-Skagway study area have a total net volume of 2,887 million board feet. An additional 300 million board feet of sawtimber is outside this area. Most of the outside area volume is inaccessible and will not contribute to allowable cut estimates for some time.

Net volume averages about 26,000 board feet per acre; gross volume, 29,800 board feet. Thus, allowance for defect, based on gross volume in these stands, amounted to about 12-1/2 percent. Defect increased as diameters increased (fig. 8). In western hemlock, defect increases from 11 percent in the 11- to 20-inch diameter classes to 36 percent in the >40-inch classes.

Softwoods comprise 90 percent of the net sawtimber volume--47.0-percent Sitka spruce and 42.7-percent western hemlock. Of the gross volume, however, 43.9 percent is Sitka spruce and 46.0 percent western hemlock, indicating that most defect was in western hemlock (19.1-percent loss); Sitka spruce was sounder (6.6-percent loss).

Distribution of volume by 2-inch diameter classes closely approximates the normal distribution curve (fig. 9); the volume is well distributed for management purposes. It should be possible to restrict most cutting to mature and overmature stands and expect them to be replaced by annual growth. Distribution of sawtimber volume by 10-inch d.b.h. classes shows most of the volume of the two major species to be in the 21- to 30-inch class.

Seventy-five percent of the sawtimber volume is in the old-growth sawtimber stand-size class. There are about 56,000 acres of old-growth sawtimber stands classed as well stocked, averaging 31,200 board feet per acre.



Hemlock sawtimber volume relationships by 10-inch d.b.h. group

Spruce sawtimber volume relationships by 10-inch d.b.h. group

Figure 8.--Gross and net volume (International 1/4-inch rule) by species and 10-inch diameter class.

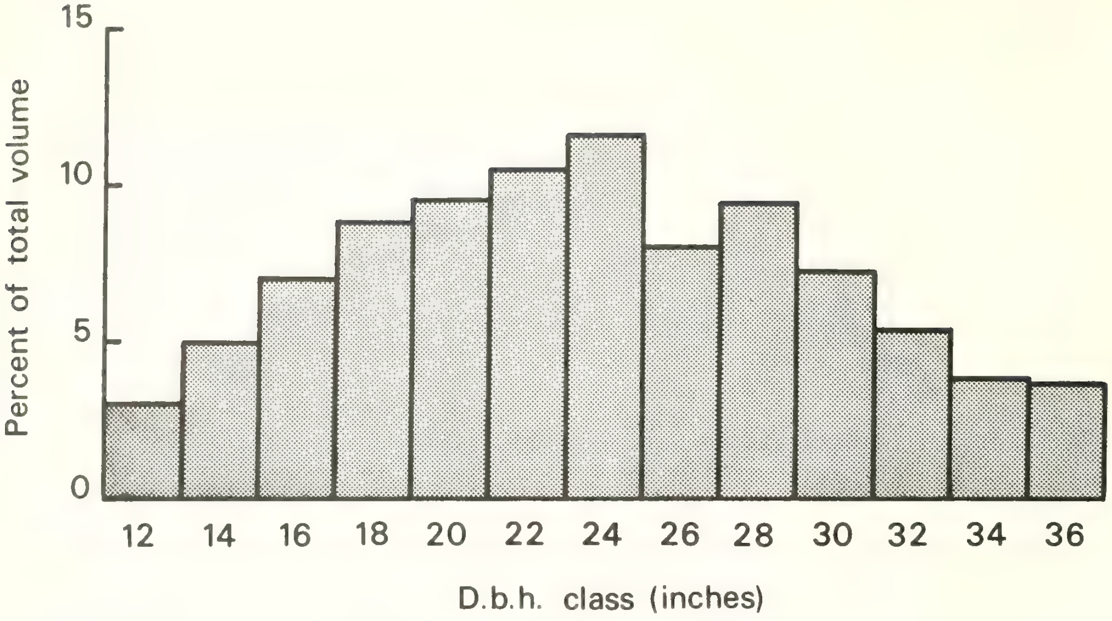


Figure 9.--Distribution of sawtimber volume by 2-inch diameter classes.

GROWING-STOCK VOLUME

The total net volume of wood in merchantable trees is 538 million cubic feet--an average of about 54 cords per acre. Old-growth sawtimber stands have 73.5 percent of the volume and average about 59 cords per acre. Young-growth sawtimber stands have 24.6 percent of the volume and average about 50 cords per acre. A 500-ton-per-day pulpmill could operate about 17 years on the total wood supply of the Haines-Skagway area without considering tree growth.

The hemlock-spruce type has 92.7 percent of the total volume. Cottonwood is the next most important type and has 6.7 percent of the total volume. Distribution of volume by species shows 45.0 percent in Sitka spruce, 44.1 percent in western hemlock, 9.6 percent in cottonwood, and 1.3 percent in other species.

Quality of Sawtimber

Of the sawtimber volume in the study area, 72 percent is estimated to be in low quality softwood logs. Only about 0.6 percent of the 2,887 million board feet is in high quality select or peeler logs. Over 20 percent of the total volume is in log grades 1 and 2, which are medium and better quality wood, mostly in softwood trees (table 17).

The hardwood volume, accounting for 8.0 percent of the total sawtimber volume, is 95-percent cottonwood. High quality, grade 1 logs comprise about 0.1 percent of the total hardwood sawtimber volume. Although birch is a minor species in this area, grade 2 or better birch logs account for about 1 percent of the high quality hardwood volume.

Current Growth

GROWTH ESTIMATES

Growth, measured in cubic feet, was estimated for all merchantable trees 5-inch d.b.h. and larger. Though trees less than 5-inch d.b.h. are important as new stands, they do not contribute to volume growth estimates.

The hardwood species are growing at a faster rate than the softwoods, although the softwoods account for 79.8 percent of the total gross annual growth. With growing-stock volume as the base, hardwoods have a 2-percent gross annual growth rate, whereas the gross annual rate for softwoods is 1 percent per year. Distributed over the total commercial forest area, the gross annual growth averages 56.19 cubic feet per acre. However, for this inventory the assumption was that old-growth sawtimber stands were not contributing to growth, i.e., that any increment in old-growth stands was offset by losses caused by decay, windthrow, and other causes. The gross annual growth amounts to 172 cubic feet per acre when distributed over just the young-growth stands on which growth was measured. On this basis, the gross growth rate is 4.4 percent.

The gross annual growth of sawtimber trees 11-inch d.b.h. and larger amounted to 27,686,000 board feet. For the area in young growth, this is an annual average of 763 board feet per acre. This is a respectable growth rate and if achieved on all 111,000 acres of commercial forest land would amount to an annual production of 84.7 million board feet.

When statistics on forest growth for the Haines-Skagway area were computed, no attempt was made to separate young- from old-growth stands. Growth was computed by a regression approach, with mean diameter growth by species group as a dependent variable and with d.b.h. and d.b.h.^{2} as independent variables. Growth for all trees was projected 10 years, and the volume change was divided by 10 for estimates of gross annual growth (table 18). Annual mortality estimates were then deducted from gross growth estimates to obtain net annual growth (table 24).

Comparison of tables 18 and 24 show that 75 percent of the gross growth of spruce is offset by mortality. Examination of the basic data showed that this probably is not due to sampling error but that stand composition is changing.

The impressions of field personnel were that the stands in the Haines-Skagway area are ecologically younger than stands of the Juneau-Sitka-Ketchikan areas. As southeast Alaska forests age and stands move toward a climax condition, the heavily stocked younger spruce stands give way to hemlock. The high rate of mortality in spruce may possibly be attributed to a change in stand composition normally associated with the transition to climax stands.

The average net annual growth for the Haines-Skagway area is 36.76 cubic feet per acre. Compared with preliminary estimates of the annual growth in the Juneau inventory unit (22.41 cubic feet), this faster growth seems to support the theory that Haines-Skagway forests are ecologically younger than the average southeast Alaska forest.

Data available from this inventory are not sufficient to formulate unqualified conclusions about growth and mortality. Additional studies of stand ecology of the area are needed.

Timber Losses and Risks

Mortality volume (2,161,000 ft^3) in the Haines-Skagway area amounted to 53.0 percent of the net annual growth (4,076,000 ft^3). This is lower than the relationship in "Timber Trends in the United States" (USDA Forest Service 1965) for Western United States (70.5 percent) but greater than the relationship for all the United States (34.6 percent). The average annual mortality for the Haines-Skagway area was 19.5 cubic feet compared with 20.5 cubic feet for all the Western United States and 11.0 cubic feet for the Nation.

Sitka spruce mortality made up 78.6 percent of all mortality for the Haines-Skagway area (table 20), with the major part of the remaining mortality in western hemlock (19.5 percent). Spruce mortality (1,699,000 ft^3) amounted to 297 percent of the spruce net growth for the region (fig. 10). Mortality for western hemlock was 18.6 percent of net growth. The predominance of mortality in spruce seems to support the theory that the stands of this region are generally approaching climax conditions with the spruce stocking giving way to hemlock.

Mortality statistics reported here for cottonwood appear very conservative (1.2 percent of cottonwood net growth; probably the cottonwood mortality sample was inadequate, resulting in an underestimate.

The risks involved in management of the Haines-Skagway stands correlate closely with those of the Pacific Northwest forests noted in "Timber Trends" (USDA Forest Service 1965). Table 22 indicates that the greatest loss of cubic-foot volume (37.8 percent) is caused by insects killing the trees, with disease causing about 11.3 percent of the loss. Fire is an insignificant factor in loss of wood in the Haines-Skagway area. However, fire must be given more consideration as a risk factor here than for the rest of southeast Alaska because of the tendency toward less rainfall in the Haines-Skagway area. Several fires occurred during the gold-rush era that would be considered serious today.

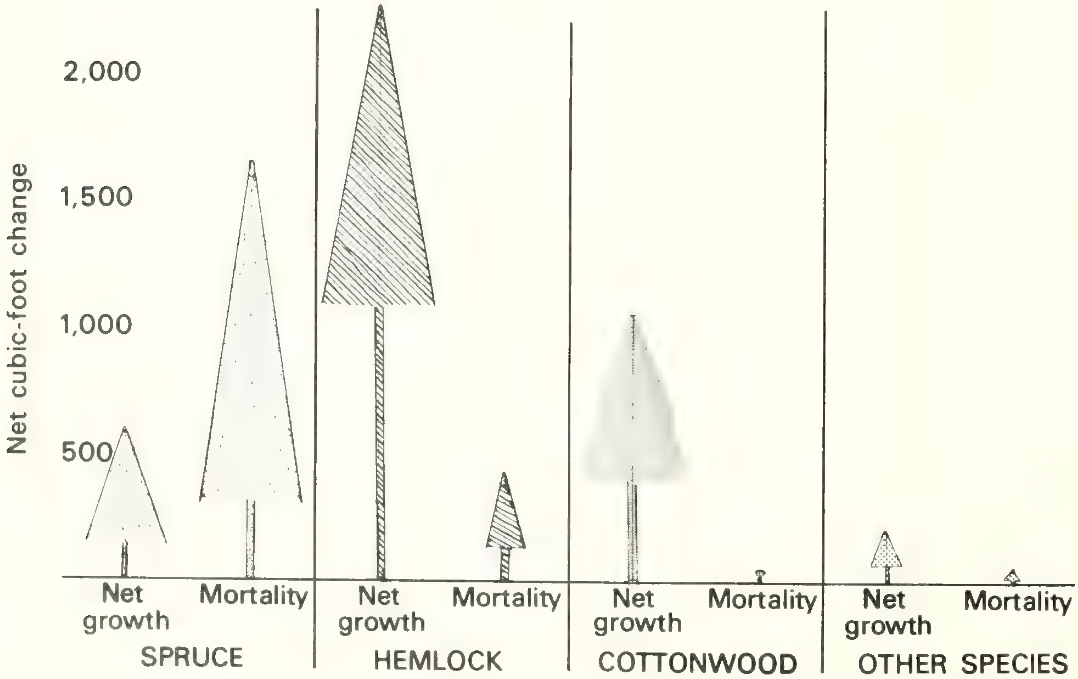


Figure 10.--Comparison of net growth and mortality by species, Haines-Skagway area.

Wind as a risk factor demands consideration. About 23 percent of the mortality volume can be attributed to wind. Although this cannot be compared with national trends, this windthrow is consistent with the rest of Alaska Panhandle where windthrow accounts for 26.3 percent of the mortality. Influence and prevailing direction of wind should be an important consideration to the forest manager when cut and leave areas are laid out in timber sales.

Other unknown or combined causes of death accounted for 27.9 percent of the loss. A few of the other factors of risk are animal damage, snow and ice breakage, flooding, and land and snow slides. All are less important risk factors, but combined they make up a substantial part of the total mortality picture.

Productivity

STOCKING CONDITION

Stand density is one good indication of site productivity. Sparse stands are generally found on sites with lower productivity; productivity usually improves as density improves. Stand density can be measured in a number of ways. An easy way of assessing stocking in the field and a method easily correlated to information obtainable from aerial photographs is crown closure. Crown closure can indicate to the forest manager stands that need some treatment to improve the stocking. Since it is related to stand volume per acre, crown closure also can indicate the extensiveness of stands suitable for harvesting.

In the Haines-Skagway area, stands on approximately 70 percent of the commercial forest land had crown closure of 70 percent or more and were classed as high density stands (table 4). Only 5 percent of the commercial forest area had low density stands with crown closure of less than 40 percent. Medium density stands, those with crown closure of from 40 to 70 percent, are found on the remaining 25 percent of the commercial forest land.

About 50 percent of all commercial forest land in the Haines-Skagway area is in old-growth sawtimber of high density. An additional 16 percent of the area is in young-growth sawtimber of high density. Thus, about two-thirds of all commercial forest land in this survey unit is in sawtimber stands that have crown closure of 70 percent or more. An additional 23 percent of the area is in sawtimber stands with from 40- to 70-percent crown closure.

VOLUME CLASSES

Another means of measuring stand productivity is to examine the volume class structure. Almost 40 percent of the commercial forest area in the Haines-Skagway area has stands averaging over 35,000 board feet per acre (table 3). On another 34 percent of the area, stands average between 15,000 and 35,000 board feet per acre; 26 percent has less than 15,000 board feet per acre.

The 15,000 board-foot class is often considered an approximation of the breaking point between operable and inoperable volume, if a given area is assumed accessible to logging equipment and is of sufficient size. Over 97 percent of the area averaging 15,000 or more board feet per acre is in hemlock-spruce forest. Cottonwood stands make up the other 3 percent. Lodgepole pine, birch, and aspen stands usually contain less than 15,000 board feet per acre.

SITE

A third means of assessing land productivity is by classification of site. Site determination reflects the wood-producing potential of the commercial forest land. The results of this report do not reflect the absolute potential productivity which might be obtained by ultimate manipulation of environmental factors. No analysis was made of soil nutrients, moisture, available light, temperature, or topography.

Old-growth, uneven-aged stands do not lend themselves to the conventional method of site evaluation, which is the total tree height divided by its age. As an index (Godman 1951) of site quality for old-growth stands, *the average number of 16-foot logs between stump and the 6-inch top in trees above average stand diameter* was used. Over 85 percent of the old-growth stands and over 59 percent of all commercial forest sites of the Haines-Skagway area supported hemlock-spruce stands averaging four or more 16-foot logs.

Site information obtained for young-growth sawtimber (table 5) was not adequate for a conclusive analysis.

Potential productivity of the Haines-Skagway area appears to be very good, especially when the average annual increment of this area is compared with the rest of Western United States. "Timber Trends" (USDA Forest Service 1965) indicates that the average net annual growth for all of Western United States is about 29.1 cubic feet, and the average net annual growth for the Haines-Skagway area is about 36.7. There may be a higher proportion of old-growth stands throughout the Western United States than in the Haines-Skagway area, accounting for the lower growth rate in the Western United States. However, the fact that the Haines-Skagway average annual increment is above the national average of 32.0 cubic feet indicates that this area has very good potential for production of wood products.

Allowable Cut

Allowable cut (Ford-Robertson 1971) is based on management decisions aimed at a sustained yield of wood products. The allowable cut can change periodically as the resource base is altered through management and our shifting economy. Much timber is available today and included in allowable cut estimates that would not have been considered a few years ago.

Computed by the Kemp formula (Davis 1966), the annual allowable cut for the total Haines-Skagway area is about 50 million board feet. This is an upper limit and probably cannot be achieved in a management plan. Some timber certainly will be withheld from cutting to satisfy other land and timber uses. Also it is difficult to include several ownerships in one management plan. Some timber owners will not be interested in sustained yield management.

With strict area control, an assumed rotation age of 100 years, and all commercial forest land committed to timber production, 1,110 acres could be cut each year. If the land productivity is equally distributed among the four producing stand-size classes, then the annual cut would come from the old-growth sawtimber stands. These stands average 29,100 board feet per acre. On this basis, the annual allowable cut would amount to only 32 million board feet.

The assumption might be made that through good forest management practices, the average volume of the best stands could be achieved during the cutting rotation on all commercial forest land. The best class identified in this inventory averaged about 38,000 board feet per acre. Annual allowable cut based on this average would be approximately 42 million board feet.

Allowable annual cut computed by the Hanzlik formula (Davis 1966) would be about 37 million board feet. This method divides the volume of mature timber by the cutting rotation and adds the annual growth. If much of the area is currently in old-growth timber and contributing little to annual growth, then the Hanzlik formula tends to underestimate allowable cut, because annual growth is computed at a low stage of the planned rotation.

By using different methods, we have obtained allowable annual cut estimates ranging from 32 million to 50 million board feet. Only a detailed management plan for the forest area committed to timber production in each ownership can resolve the question of allowable cut.

Most of the harvest will come from State land. Until the amount of land classified for timber production is known and a management plan prepared, the allowable cut from State land cannot be determined. However, the maximum cut that can be sustained from all State land probably does not exceed 39 million board feet.

Using a computer program called TRAS (Timber Resource Analysis System) (USDA Forest Service 1970), we projected the State-owned forest land 100 years. Current growth and mortality rates were used throughout, and actual harvest records were used from 1965 through 1973. From 1974 to the end of the projection, the annual harvest removal was set at 19.5 million board feet (inventory volume, Scribner scale). After 100 years, 38 percent of the original inventory was still available for harvest. This computation does not arrive at an allowable cut, but it does help predict what may be the result if specific management decisions are carried forward for any given period of time.

TIMBER PROCESSING AND MARKETING

Haines has become an important shipping point for the export of logs and cants (squared and partially squared timbers) (fig. 11). Japanese ships carried about 782,000 cubic feet of logs and cants from Haines in 1963. In 1967 the volume increased nearly 10½ times to a total of 8,210,000 cubic feet (table 27). Ninety percent of the volume shipped was cants (Massie and Haring 1969).

Logs are being exported from privately owned land. Logs from State and National Forest land must pass through a primary manufacturing plant before export. In recent years the Haines area has had two sawmills--one cutting cants for export and the other

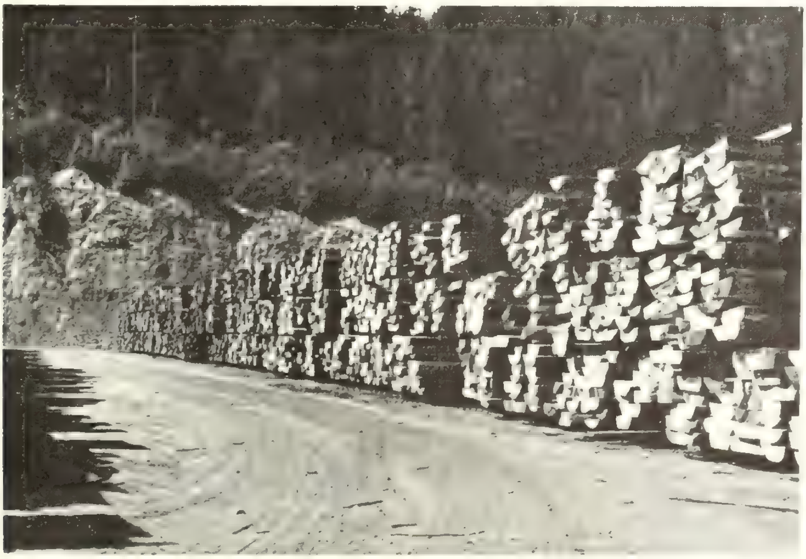


Figure 11.--Sitka spruce cants decked at Haines in preparation for shipment to Japan.

converted to sawing standard lumber for a brief time. The one sawing standard lumber ceased operation in late 1975. At their peak these two mills and the supporting logging companies employed about 125 men.

Before 1963, one or two portable sawmills operated intermittently to supply local needs and to truck some construction lumber to Whitehorse and Fairbanks. In 1952, Haines had two sawmills, each with a daily production capacity of about 10,000 board feet. However, the local needs at that time were for about 150,000 board feet annually, and neither mill operated for more than about 42 days in any one year (Cooley 1953).

In the summer of 1967, the Institute of Social, Economic and Government Research, University of Alaska, made a detailed study of forest utilization in the Haines area to determine its economic significance and whether possible changes could lead to increased benefits to the community (Massie and Haring 1969). As a result of this study, Massie and Haring concluded (quoted from Massie and Haring (1969) with permission):

> (1) The isolated location of the Haines community and the existence of unattractive domestic shipping costs have to date limited profitable sales of forest products from Haines to a one buyer market--Japan.

This conclusion appears to still be true. One sawmill shipped rough, green lumber to southeast and interior Alaska communities for a brief period but ceased operations in late 1965. The other mill continues to produce for the Japanese market.

> (2) Present Japanese product specifications are not conducive to utilizing a large portion of the timber resource; although improvements have been noted, only selected components of the resource have been harvested and utilized.

> (3) The current trend in cutting practice in the area favors the harvest of one species (Sitka spruce) and large volumes of uncut western hemlock are being left. Also, current utilization favors higher quality timber, resulting in lower quality old growth timber becoming an increasing proportion of the remaining stands.

At the time comments 2 and 3 were made, the Japanese market was only interested in Sitka spruce cants. Now, hemlock lumber and squares are produced for the Alaska and Japanese markets; and one mill produces chips from under-size and low quality logs and from mill residues. Utilization practices are much improved.

> (4) During 1966-67 about 5,300 board feet per acre of sound wood was left as residue in harvesting. Some 20 percent of this volume was of a size and quality acceptable for use in manufacture under current market specifications. Approximately 16 percent of the mill log inputs used in cant manufacturing end up as slab waste. These wastes could be utilized in chipping to increase the overall economic contribution of the resource.

As a result of improved markets and install tion of new processing equipment, most of the material referred to by Massie and Haring in this comment is now being used.

> (5) Since the Haines cant mills do not own supplies of standing timber, and since private ownership of timber in the area is only a minor source of supply, the mills are now caught between public timber (State of Alaska) ownership policies and product buyer desires. In order to conform to market specifications, the mills are often forced to directly or indirectly oppose some public timber management policies which support sustained yield and increased resource productivity.

The conflicts referred to here have been worked out, and production from State land now conforms to sustained yield objectives. Since 1967 (see table 28), about 40 percent of the log volume required by the Haines sawmills has been obtained from the Tongass National Forest.

(6) Additional markets and new manufacturing opportunities are needed in the area to better utilize the timber resource. The manufacture of pulpchips appears to be a feasible complimentary operation to the cutting of cants. Its successful introduction would reduce the amount of timber now being wasted, and would enable utilization of lower quality timber not now being harvested.

The conditions of this comment have been met.

(7) On nearly every basis of comparison, the "better" utilization alternative economically for the Haines area is cant manufacturing, rather than lumber manufacture. This would be even more beneficial with the introduction of pulpchipping, which would utilize slab waste from cant cutting and/or logging residue.

Pulp chips are now being produced.

(8) Limited and temporary evidence indicated that round log export, where permitted in the Haines area, provided greater gross revenues per unit volume than cant manufacture in 1967.

Export of round logs is still restricted to logs produced from private land.

(9) Volume conversion factors between mill inputs and outputs are not standardized (i.e., are not commonly recognized by other than the specific trade). Outputs on a mill tally basis, when compared with standardized units of measure (i.e., actual board feet as is the case with squares or lumber), are consistently underestimated. If mill tally is assumed to be equivalent to a "Brereton" scale (i.e., actual board foot content of the cant without allowances), the underestimation of volume amounts to approximately 17 percent. In other words, if cants are considered as "lumber" type products, production has been much larger than commonly reported and selling prices effectively lower than popularly perceived.

(10) Any additional annual increase in timber harvesting and forest product manufacturing in Haines might endanger a sustained yield management program of the Haines area timber unless the timbershed is expanded. Additional timber could come from the Tongass National Forest or from the Province of British Columbia.

As noted under item 5, about 40 percent of present log requirements are now obtained from the Tongass National Forest.

(11) More than one-third of the employment in the Haines area is dependent on the export of forest products. On an annual basis, approximately 2.6 jobs result from every million board feet of logs manufactured into cants and exported. Government is the next most important employer, generating slightly less than one-quarter of all jobs in the area.

Since 1967, tourism and fishing activities have displaced government employment in importance.

(12) The Haines growth experience in employment and income are typical of that which could be forecast for other similarly remotely situated Alaskan communities, that have sufficient commercial forests and marketable species. Japanese buyers represent a firm export market, and local benefits from this type of foreign trade are substantial.

(13) Income benefits could not be fully substantiated for the community. Based on direct gross income (wages and salaries), a provisional estimate of approximately $13,500 per person employed in harvesting, handling or manufacturing a forest product (including management) was formulated.

(14) Community adjustment to a new manufacturing industry rarely represents a "cure" for local unemployment problems by itself. Manufacturers hire laborers with specific and current skills, and frequently these are imported from outside the community. Local hiring normally is a more gradual process. Well trained and skilled Alaskans must be willing to

migrate to those areas where natural resource-based manufacturing is developing, or face the prospect of lost job opportunities.

(15) Logging and milling operations represent a kind of manufacturing that is relatively stable seasonally, and in which the longer run employment opportunities are favorable. This new manufacturing represents a more broad and diversified industrial base in the community and is appropriate if employment conditions are to be improved year after year. In particular, it represents a way in which young adults now entering the labor force might be employed locally, or at least within the state.

(16) Wood products manufacturing of the type observed in Haines represents an example of a single community within the framework of longer term forestry development of national forests and state forest lands. Taken in this historical perspective, additional mills should appear in fairly rapid order at other similar locations.

As already noted, a number of important changes have taken place in harvesting and utilization practices since Massie and Haring's study. More changes can be expected with shifting markets and economic conditions. Demand for wood products is expected to increase at home and abroad. To share in new or expanding markets, the Haines industries would need new sources of logs.

The log volume supplied by the State from 1961 through 1973 (table 28) averages 19.9 million board feet (Scribner rule, Bureau scale). If all present State forest land of the Haines-Skagway area remains available for timber production, it should be possible to sustain the present average log supply. Supplies presently obtained from private land and from the Tongass National Forest may continue to be obtainable. Log supplies beyond these sources do not appear to be readily available.

Definition of Terms

LAND USE CLASSES

FOREST LAND.--Includes (a) lands that are at least 10 percent stocked by trees of any size and capable of producing timber or other wood products, or of exerting influence on the climate or on the water regime; (b) land from which trees have been removed to less than 10-percent stocking, and which has not been developed for other use. (Forested tracts and islands of less than 10 acres and isolated strips of timber less than 120 feet wide are excluded.)

Commercial.--Forest land which is (a) producing or capable of producing usable crops of industrial wood (will net a minimum of 8,000 board feet per acre, International ¼-inch rule); (b) economically accessible now or in the foreseeable future; and (c) not withdrawn from timber utilization.

Operability.--For management purposes, the commercial forest land is classified as operable (or accessible) and inoperable (or inaccessible). The inoperable class include stands on unstable soils, slopes too steep to log without doing serious damage to the site, and stands that would not pay the cost of logging, using costs and methods current at the time of inventory. Stands that require new methods, such as helicopter or balloon logging, are not in the operable class.

Noncommercial.--Forest land incapable of producing usable industrial wood because of adverse site conditions or withdrawn for specified purposes.

Unproductive.--Noncommercial forest land which does not now support or will not produce a minimum of 8,000 board feet per acre.

Productive.--Forest land capable of producing usable crops of industrial wood, but withdrawn for specified purposes through statute, ordinance, or administrative order.

NONFOREST LAND.--All land not qualifying as forest land. Includes land which has never supported forest growth; land from which the forest has been removed to less than 10-percent stocking and has been developed for other use, such as agricultural, residential, or industrial; all land in thickly populated urban and suburban areas; and water areas under 40 acres classified by the Bureau of the Census as land. Glaciers, icefields, marshland above mean high tide, permanent brush fields, muskegs less than 10 percent stocked to trees of any size, and barren mountain tops are examples of lands which have never supported forest growth.

FOREST TYPES

Forest types are classified on the basis of the species or species group that accounts for the major portion of the stand in terms of net board-foot volume for sawtimber, cubic-foot volume for poletimber, and number of trees for seedling-sapling stands.

Sitka spruce.--Forests in which Sitka spruce is predominant.

Hemlock-Sitka spruce.--Forest in which 50 percent or more of the stand is western hemlock but in which Sitka spruce makes up 30 to 49 percent of the stand.

Hemlock.--Forests predominantly western hemlock except when Sitka spruce comprises 30 to 49 percent of the stand.

Hardwood.--Forests predominantly cottonwood or red alder, singly or in combination.

TREE AND STAND CLASSES

SAWTIMBER TREES.--Live trees of commercial species at least 11.0-inch d.b.h. with at least 25 percent of their gross board-foot volume free from rot or other defect and that contain at least one merchantable saw log.

Merchantable saw log.--For softwoods, not less than 16 feet long and containing a minimum of 20 board feet between a stump height equal to d.b.h. but not exceeding 4½ feet and a merchantable top equal to 40 percent of d.b.h., except for small trees where the minimum top is 6 inches.

For hardwoods, not less than one 8-foot log to a minimum top of 8-inch d.i.b. for small trees and 40 percent of d.b.h. for large trees. After deductions for defect, a saw log must contain a net scale of at least 33-1/3 percent of the gross.

Upper stem.--The section of the bole or main stem of a sawtimber tree from the merchantable top to a minimum top diameter of 4.0 inches inside the bark.

POLETIMBER TREES.--Live trees 5.0 inches to, but not including, 11.0 inches in d.b.h. These trees are of sufficiently good form and condition to indicate that they will grow into merchantable sawtimber trees.

SAPLING AND SEEDLING TREES.--Live trees of commercial species less than 5.0-inch d.b.h. and of sufficiently good form and vigor to indicate that they will grow into merchantable sawtimber trees.

GROWING-STOCK TREES.--All live trees, except cull trees, of commercial species.

CULL TREES.--Live trees 5.0-inch d.b.h. and over that do not qualify as sawtimber or poletimber trees due to poor form, limbiness, rot, or other defect.

Rotten cull trees contain excessive decay.

Sound cull trees have excessive crook, sweep, or large limbs.

SALVABLE DEAD TREES.--Standing, dead, sawtimber-size trees containing at least one merchantable saw log having sound volume equal to at least 50 percent of the gross volume in the tree.

MORTALITY TREES.--Trees 5.0-inch d.b.h. and larger which died of natural causes and were not cull trees at the time of death.

SAWTIMBER STAND.--Forest stands in which the minimum volume for coniferous types is 8,000 net board feet (International ¼-inch rule) per acre in growing-stock trees 11.0 inches d.b.h. and larger. For hardwood sawtimber stands the minimum volume is 4,000 net board feet (International ¼-inch rule) per acre.

Old growth.--Sawtimber stands in which the majority of volume is in sawtimber trees more than 150 years of age.

Young growth.--Sawtimber stands in which the majority of volume is in sawtimber trees less than 150 years of age.

POLETIMBER STAND.--Stands failing to meet the sawtimber stand specification, but at least 10 percent stocked with poletimber and larger growing-stock trees, and with at least half the minimum stocking in poletimber trees.

SAPLING AND SEEDLING STAND.--Stands not qualifying as either sawtimber or poletimber, but having at least 10-percent stocking of trees of commercial species and with at least half the minimum stocking in seedlings and saplings.

NONSTOCKED AND OTHER AREAS.--Commercial forest land less than 10 percent stocked with growing-stock trees.

VOLUME CLASSES

SAWTIMBER VOLUME.--The net volume in board feet, International ¼-inch rule, of merchantable saw logs in live sawtimber trees of commercial species.

GROWING-STOCK VOLUME.--The net volume in cubic feet of sound wood in live sawtimber and poletimber trees of commercial species from the stump to a minimum 4.0-inch top inside the bark.

TOTAL VOLUME.--The net volume in cubic feet of sound wood in live and salvable dead sawtimber and poletimber trees and in sound and rotten cull trees of commercial species from the stump to a minimum 4.0-inch top inside the bark. Included is the volume of hardwood limbs on sawtimber trees to a minimum diameter of 4.0 inches inside the bark.

LOG GRADES

Sample western hemlock and Sitka spruce trees were graded in 16-foot log lengths. However, when any 12- or 14-foot section of a log was better than the entire log, the grade of the shorter section was given to the entire log.

The rules used were from the January 1954 edition of Official Log Scaling and Grading Rules for the Puget Sound, Grays Harbor, Southern Oregon, and Northern California Bureaus.

ABBREVIATIONS USED

DBH OR d.b.h.--Abbreviation for diameter at breast height. This measurement is taken 4½ feet above the ground on the uphill side of the tree.

d.i.b.--Abbreviation for diameter inside the bark. This measurement may be taken at any specified location.

d.o.b.--Abbreviation for diameter outside the bark. This measurement may be taken at any specified location.

2-inch diameter class.--If the classes are expressed as 6, 8, 10 inches, etc., this means that the diameters included are from 5.0 through 6.9, 7.0 through 8.9, 9.0 through 10.9, etc.

STOCKING CLASSES

Stocking is a measure of how effectively the area is being utilized by growing stock. No stocking measure was assigned to old-growth stands. For young-growth stands, ocular estimates were made of the crown cover of sawtimber trees on the 10 acres surrounding each plot location. The stocking of poletimber, saplings, and seedlings was based on the number of stems per acre. The following classes and guides were used:

Poletimber.--

Stems per acre	Percent stocked
210 or more	70
120 to 210	40
30 to 120	10

SAPLINGS AND SEEDLINGS.--Stocking was measured on ten 4-milacre circular plots. Two or more established saplings or seedlings were required to stock a 4-milacre plot. Stocking of the area was determined by the number of milacre locations that were stocked. Thus, if six of the ten 4-milacre locations were stocked, the area was judged to be 60 percent stocked.

Area stocking classes	Percent
Nonstocked	0-9
Poorly stocked	10-39
Medium stocked	40-69
Well stocked	70-100

VOLUME MEASUREMENTS

BOARD FOOT.--A board 1 foot long, 1 foot wide, and 1 inch thick. The bark is usually eliminated from this measurement. In practice, the working unit is 1,000 board feet and may be abbreviated to M fbm.

CUBIC FOOT.--A cube 12 inches on a side. The cubic-foot volume of a log or tree is commonly computed by Smalian's formula (Bruce and Schumacher 1950).

INTERNATIONAL ¼-INCH LOG RULE.--A rule used to determine the log volume in board feet (Bruce and Schumacher 1950).

ALLOWABLE CUT

Allowable cut, or yield determination, is defined as "The calculation, more directly by volume regulation, less directly by area regulation, of the amount of forest produce that may be harvested, annually or periodically, from a specified area over a stated period, in accordance with the objects of management" (Ford-Robertson 1971).

A number of formulas are available to make this estimate. The Kemp formula (Davis 1966) is easy to apply with the kind of inventory data available. Usually this formula is applied to areas in which there is a surplus of timber beyond rotation age. The objective is to determine the cut that will achieve an approximately equal distribution of area by age or stand-size classes within a rotation.

The Kemp formula:

$$\text{Annual cut} = \frac{7A+5A_1+3A_2+A_3}{4R}\ (MA)$$

A = area of sawtimber stands
A_1= area of poletimber stands
A_2= area of seedling and sapling stands
A_3= nonstocked area
$A+A_1+A_2+A_3$= total commercial forest land area
4 = number of stand-size classes
R = rotation in years
MA = average volume per acre of current sawtimber stands, the A stratum.

The chief use of the Hanzlik formula (Davis 1966) is for estimation of an average annual cut by volume that serves as a starting point for an area-volume check. This area-volume check, not the formula, is the essence of the method.

The Hanzlik formula:

$$\text{Allowable cut} = \frac{V_m}{R} + I$$

V_m = volume of mature timber
R = rotation
I = mean annual increment.

RELIABILITY OF ESTIMATES

Accuracy of the estimates.--Errors which affect the accuracy of the area and volume estimates in this report may arise from two sources:

1. *Nonsampling errors.*--These are human mistakes in judgment, measurement, recording, or arithmetic. There is no practical method of finding out just how often such errors occur. These errors are kept to a minimum, however, by a diligent effort to maintain a high degree of accuracy in the collection and compilation of data and by a close check of all phases of the work.

2. *Sampling errors.*--These errors arise from using sampling procedures rather than making a 100-percent inventory. These errors can be measured. They are the only measurable errors involved in computing the reliability of the estimates.

Literature Cited

Bruce, Donald, and Schumacher, Francis X.
1950. Forest mensuration. 483 p., illus. McGraw-Hill Book Co., Inc., New York.

Cooley, Richard A.
1953. An economic study, Haines, Alaska. 100 p., illus. Alaska Dev. Board, Juneau. (State Hist. Libr.)

Davis, Kenneth P.
1966. Forest management: regulation and valuation. 519 p., illus. McGraw-Hill Book Co.

Ford-Robertson, F. C. (ed.).
1971. Terminology of forest science, technology practice and products. 349 p. Soc. Am. For., Washington, D.C.

Godman, R. M.
1951. A site classification and "quick-cruise" volume table for climax stands. USDA For. Serv. Alaska For. Res. Cent. Tech. Note 11, 3 p.

Massie, Michael R. C., and Robert C. Haring.
1969. The forest economy of Haines, Alaska. Inst. Soc., Econ. and Gov. Res. SEG Rep. 20, 191 p., illus. Univ. Alaska, Fairbanks.

U.S. Department of Agriculture,
Forest Service.
1965. Timber trends in the United States. For. Resour. Rep. 17, 235 p., illus.

U.S. Department of Agriculture,
Forest Service.
1970. TRAS, a computer program for the projection of timber volume. U.S. Dep. Agric. Handb. 377, 24 p.

Tables of Reliability

Reliability of the forest-area estimates

Forest-land class	All ownerships area	Sampling error	Allowable error
	Acres	*Percent*	*Percent*
Commercial	110,977	± 6.9	± 9.0
Noncommercial	82,591	± 9.2	±34.8
All forest land	193,568	± 1.8	--
Nonforest	250,570	± 1.4	--
Water (under 40 acres)	5,184	±12.4	--
Total	449,322	± .3	--

The probability is 0.667 that the actual commercial forest land area is within ±6.9 percent of the estimated area.

Reliability of the commercial forest volume estimates

Forest type group	Total volume	Sampling error	Allowable error
	Cubic feet	*Percent*	*Percent*
Growing stock:			
Hardwoods	57,619,242	±20.5	--
Softwoods	480,728,094	± 9.9	--
Total	538,347,336	± 8.9	± 6.8
	Board feet, Scribner		
Sawtimber:			
Hardwoods	256,004,798	±22.2	--
Softwoods	2,400,939,100	±10.3	--
Total	2,656,943,940	± 9.3	--

The probability is 0.667 that the actual cubic-foot volume of growing stock is within ±8.9 percent of the estimated total cubic-foot volume and that the actual sawtimber board-foot volume is within ±9.3 percent of the estimated total sawtimber volume.

Detailed Tables of Estimates

Table 1--*Area by land class, Haines-Skagway area, Alaska, 1965*

Land class	Thousand acres	Percent
Forest land:		
Commercial	111.0	24.7
Noncommercial	82.6	18.4
Total	193.6	43.1
Nonforest land:		
Nonforest	250.5	55.7
Water[1]	5.2	1.2
Total	255.7	56.9
Total land area	449.3	100.0

[1] Area classified as water by Survey standards but defined by Bureau of the Census as land.

Table 2--*Area of commercial forest land by stand-size class, Haines-Skagway area, Alaska, 1965*

Stand-size class	Thousand acres	Percent
Seedlings and saplings	2.8	2.5
Poletimber	3.9	3.5
Young-growth sawtimber	29.6	26.7
Old-growth sawtimber	74.7	67.3
Total	111.0	100.0

Table 3--*Area of commercial forest land by volume class, Haines-Skagway area, Alaska, 1965*

Stand volume (board feet per acre)[1]	Thousand acres	Percent
Less than 1,499	4.5	4.1
1,500 - 4,999	.9	.8
5,000 - 14,999	23.7	21.4
15,000 - 24,999	16.6	14.9
25,000 - 34,999	21.4	19.3
35,000 and over	43.9	39.5
Total	111.0	100.0

[1] Net volume, International 1/4-inch rule.

Table 4--*Area of commercial forest land by stand-size class and stocking class, Haines-Skagway area, Alaska, 1965*

Stand-size class	Well stocked	Medium stocked	Poorly stocked	All classes	Percent
	- - - - - - -	*Thousand acres*	- - - - - -		
Seedlings and saplings	0	1.9	0.9	2.8	2.5
Poletimber	3.4	.5	0	3.9	3.5
Young-growth sawtimber	17.9	11.7	0	29.6	26.7
Old-growth sawtimber	55.9	14.5	4.3	74.7	67.3
Total	77.2	28.6	5.2	111.0	100.0
Percent	69.5	25.8	4.7	100.0	

Table 5--*Area of commercial forest land by site and stand-size class and forest type, Haines-Skagway area, Alaska, 1965*

Site and stand-size class	Spruce-hemlock	Birch	Cottonwood	All types	Percent
	Thousand acres				
Young-growth sawtimber:					
Site 40	1.0	0	0	1.0	0.9
Site 50	0	0	0	0	0
Site 60	0	0	0	0	0
Site 70	.9	0	0	.9	.8
Site 80	2.6	0	0	2.6	2.3
Site 90	.4	0	0	.4	.4
Site 100	2.1	0	0	2.1	1.9
Site 110	0	0	0	0	0
Site 120	3.0	0	0	3.0	2.7
Site 130	0	0	0	0	0
Site 140	.9	0	0	.9	.8
Site 150	2.1	0	0	2.1	1.9
Unclassified	5.1	0	11.5	16.6	15.0
Total	18.1	0	11.5	29.6	26.7
Old-growth sawtimber:					
1 log site	0	0	0	0	0
2 log site	.9	.9	0	1.8	1.6
3 log site	6.5	0	.9	7.4	6.7
4 log site	34.5	0	1.4	35.9	32.3
5 log site	23.4	0	0	23.4	21.1
6 log site	6.2	0	0	6.2	5.6
Total	71.5	.9	2.3	74.7	67.3
Seedlings and saplings	1.8	0	1.0	2.8	2.5
Poletimber	2.5	.9	.5	3.9	3.5
All stand-size classes	93.9	1.8	15.3	111.0	100.0
Percent	84.6	1.6	13.8	100.0	

Table 6--*Area of commercial forest land by forest type, Haines-Skagway area, Alaska, 1965*

Forest type	Thousand acres	Percent
Hemlock-Sitka spruce	93.9	84.6
Birch	1.8	1.6
Cottonwood	15.3	13.8
Total	111.0	100.0

Table 7--*Area of noncommercial forest land by softwoods and hardwoods, Haines-Skagway area, Alaska, 1965*

Type	Thousand acres	Percent
Softwoods	65.4	79.2
Hardwoods	17.2	20.8
Total	82.6	100.0

Table 8--*Number of growing stock trees on commercial forest land by diameter class and species, Haines-Skagway area, Alaska, 1965*

Diameter class[1/]	Softwoods					Hardwoods				All species	Percent
	Lodgepole pine	Sitka spruce	Mountain hemlock	Western hemlock	Total	Quaking aspen	Paper birch	Black cottonwood	Total		
					Thousand trees						
1.0-2.9	--	817	--	3,935	4,752	--	478	33	511	5,263	23.0
3.0-4.9	--	521	--	2,167	2,688	--	218	257	475	3,163	13.8
5.0-6.9	12	575	41	1,894	2,522	25	86	43	154	2,676	11.7
7.0-8.9	12	516	12	1,426	1,966	12	155	88	255	2,221	9.7
9.0-10.9	12	528	--	759	1,299	74	141	85	300	1,599	7.0
11.0-12.9	5	463	6	724	1,198	42	76	128	246	1,444	6.3
13.0-14.9	4	477	5	618	1,104	9	39	145	193	1,297	5.7
15.0-16.9	6	436	5	544	991	--	8	171	179	1,170	5.1
17.0-18.9	--	399	3	448	850	--	11	93	104	954	4.2
19.0-20.9	--	301	--	382	683	--	5	75	80	763	3.3
21.0-22.9	2	271	--	271	544	--	3	83	86	630	2.7
23.0-24.9	--	221	--	268	489	--	--	67	67	556	2.4
25.0-26.9	--	101	--	163	264	--	--	44	44	308	1.3
27.0-28.9	--	135	--	129	264	--	1	32	33	297	1.3
29.0-30.9	--	82	--	109	191	--	--	12	12	203	.9
31.0-32.9	--	54	--	57	111	--	--	9	9	120	.5
33.0-34.9	--	45	--	38	83	--	--	6	6	89	.4
35.0-36.9	--	30	--	27	57	--	--	7	7	64	.3
37.0-38.9	--	5	--	21	26	--	--	3	3	29	.1
39.0-40.9	--	14	--	3	17	--	--	6	6	23	.1
41.0-42.9	--	4	--	4	8	--	--	2	2	10	[2/]
43.0-44.9	--	3	--	7	10	--	--	5	5	15	.1
45.0 and larger	--	10	--	--	10	--	--	2	2	12	.1
All diameters	53	6,008	72	13,994	20,127	162	1,221	1,396	2,779	22,906	100.0
Percent	0.2	26.2	0.3	61.2	87.9	0.7	5.3	6.1	12.1	100.0	

[1/] Inches at breast height.

[2/] Less than 0.1 percent.

Table 9--*Net volume of timber on commercial forest land by class of timber and softwoods and hardwoods, Haines-Skagway area, Alaska, 1965*

Class of timber	Softwoods	Hardwoods	Total	Percent
	- - - - *Thousand cubic feet* - - - -			
Sawtimber trees:				
Saw-log portion	435,091	45,513	480,604	85.0
Upper stem portion	18,134	7,409	25,543	4.5
Total	453,225	52,922	506,147	89.5
Poletimber trees	27,503	4,697	32,200	5.7
All growing-stock trees	480,728	57,619	538,347	95.2
Rough trees	488	390	878	.2
Rotten trees	8,967	1,148	10,115	1.8
Salvable dead trees	16,012	8	16,020	2.8
Total	506,195	59,165	565,360	100.0
Percent	89.5	10.5	100.0	

Table 10--*Net volume of growing stock on commercial forest land by stand-size class and forest type, Haines-Skagway area, Alaska, 1965*

Stand-size class	Hemlock-Sitka spruce	Birch	Cotton-wood	Total	Percent
	- - - - - - *Thousand cubic feet* - - - - -				
Seedlings and saplings	1,268	--	173	1,441	0.3
Poletimber	6,499	2,119	143	8,761	1.6
Young-growth sawtimber	106,575	--	25,827	132,402	24.6
Old-growth sawtimber	384,465	1,357	9,921	395,743	73.5
Total	498,807	3,476	36,064	538,347	100.0
Percent	92.7	0.6	6.7	100.0	

Table 11--*Net volume of sawtimber on commercial forest land by stand-size class and forest type, Haines-Skagway area, Alaska, 1965*

Stand-size class	Hemlock-Sitka spruce	Birch	Cotton-wood	Total	Percent
	Thousand board feet, - - - International 1/4-inch rule - - -				
Seedlings and saplings	6,633	--	146	6,779	0.2
Poletimber	14,057	7,072	380	21,509	.8
Young-growth sawtimber	569,940	--	115,217	685,157	23.7
Old-growth sawtimber	2,104,772	6,754	62,517	2,174,043	75.3
Total	2,695,402	13,826	178,260	2,887,488	100.0
Percent	93.3	0.5	6.2	100.0	
	Thousand board feet, Scribner rule				
Seedlings and saplings	6,141	--	127	6,268	0.2
Poletimber	12,974	6,393	331	19,698	.7
Young-growth sawtimber	525,041	--	101,038	626,079	23.6
Old-growth sawtimber	1,944,328	6,188	54,383	2,004,899	75.5
Total	2,488,484	12,581	155,879	2,656,944	100.0
Percent	93.7	0.5	5.8	100.0	

Table 12--*Net volume of growing stock on commercial forest land by stand-size class and stocking class, Haines-Skagway area, Alaska, 1965*

Stand-size class	Well stocked	Medium stocked	Poorly stocked	All classes	Percent
	- - - - - Thousand cubic feet - - - - -				
Seedlings and saplings	--	1,091	350	1,441	0.3
Poletimber	8,618	143	--	8,761	1.6
Young-growth sawtimber	106,774	25,628	--	132,402	24.6
Old-growth sawtimber	318,528	62,564	14,651	395,743	73.5
Total	433,920	89,426	15,001	538,347	100.0
Percent	80.6	16.6	2.8	100.0	

Table 13--*Net volume of sawtimber on commercial forest land by stand-size class and stocking class, Haines-Skagway area, Alaska, 1965*

Stand-size class	Well stocked	Medium stocked	Poorly stocked	All classes	Percent
		Thousand board feet, - - - - International 1/4-inch rule - - - -			
Seedlings and saplings	--	5,226	1,553	6,779	0.2
Poletimber	21,129	380	--	21,509	.8
Young-growth sawtimber	562,943	122,214	--	685,157	23.7
Old-growth sawtimber	1,746,385	341,640	86,018	2,174,043	75.3
Total	2,330,457	469,460	87,571	2,887,488	100.0
Percent	80.7	16.3	3.0	100.0	
		Thousand board feet, Scribner rule			
Seedlings and saplings	--	4,830	1,438	6,268	0.2
Poletimber	19,367	331	--	19,698	.7
Young-growth sawtimber	517,611	108,468	--	626,079	23.6
Old-growth sawtimber	1,614,683	312,497	77,719	2,004,899	75.5
Total	2,151,661	426,126	79,157	2,656,944	100.0
Percent	81.0	16.0	3.0	100.0	

Table 14--*Net volume of growing stock on commercial forest land by diameter class and species, Haines-Skagway area, Alaska, 1965*

Diameter class[1]	Softwoods					Hardwoods				All species	Percent
	Lodgepole pine	Sitka spruce	Mountain hemlock	Western hemlock	Total	Quaking aspen	Paper birch	Black cottonwood	Total		
	Thousand cubic feet										
5.0-6.9	33	1,146	109	3,673	4,961	63	142	85	290	5,251	1.0
7.0-8.9	56	2,684	56	6,595	9,391	87	795	486	1,368	10,759	2.0
9.0-10.9	130	5,596	--	7,425	13,151	849	1,355	835	3,039	16,190	3.0
11.0-12.9	51	7,614	99	10,195	17,959	460	846	1,586	2,892	20,851	3.9
13.0-14.9	68	12,264	104	14,931	27,367	155	556	3,063	3,774	31,141	5.8
15.0-16.9	61	16,677	148	18,667	35,553	--	122	5,551	5,673	41,226	7.7
17.0-18.9	--	21,697	169	21,754	43,620	--	317	3,952	4,269	47,889	9.0
19.0-20.9	--	21,463	--	24,488	45,951	--	172	4,088	4,260	50,211	9.3
21.0-22.9	63	25,191	--	21,561	46,815	--	149	6,138	6,287	53,102	9.9
23.0-24.9	--	24,887	--	26,410	51,297	--	--	5,848	5,848	57,145	10.6
25.0-26.9	--	14,766	--	19,044	33,810	--	--	4,861	4,861	38,671	7.2
27.0-28.9	--	23,598	--	16,927	40,525	--	94	3,586	3,680	44,205	8.2
29.0-30.9	--	15,491	--	16,290	31,781	--	--	1,726	1,726	33,507	6.2
31.0-32.9	--	12,971	--	9,945	22,916	--	--	1,431	1,431	24,347	4.5
33.0-34.9	--	10,045	--	5,993	16,038	--	--	940	940	16,978	3.1
35.0-36.9	--	9,359	--	5,109	14,468	--	--	1,307	1,307	15,775	2.9
37.0-38.9	--	1,910	--	4,546	6,456	--	--	831	831	7,287	1.3
39.0-40.9	--	5,208	--	808	6,016	--	--	1,795	1,795	7,811	1.5
41.0-42.9	--	2,001	--	969	2,970	--	--	631	631	3,601	.6
43.0-44.9	--	1,904	--	2,090	3,994	--	--	1,935	1,935	5,929	1.1
45.0 and larger	--	5,689	--	--	5,689	--	--	782	782	6,471	1.2
All diameters	462	242,161	685	237,420	480,728	1,614	4,548	51,457	57,619	538,347	100.0
Percent	0.1	45.0	0.1	44.1	89.3	0.3	0.8	9.6	10.7	100.0	

[1] Inches at breast height.

Table 15--*Net board-foot volume of sawtimber on commercial forest land by diameter class and species, Haines-Skagway area, Alaska, 1965*

Diameter class[1]	Softwoods					Hardwoods				All species	Percent
	Lodgepole pine	Sitka spruce	Mountain hemlock	Western hemlock	Total	Quaking aspen	Paper birch	Black cottonwood	Total		
	Thousand board feet, International 1/4-inch rule										
11.0-12.9	153	33,507	432	41,628	75,720	1,433	2,968	6,029	10,430	86,150	3.0
13.0-14.9	271	58,321	463	69,357	128,412	587	2,122	13,834	16,543	144,955	5.0
15.0-16.9	269	84,964	701	92,319	178,253	--	461	27,356	27,817	206,070	7.0
17.0-18.9	--	116,111	896	114,498	231,505	--	1,381	20,454	21,835	253,340	8.8
19.0-20.9	--	118,750	--	134,158	252,908	--	660	21,499	22,159	275,067	9.5
21.0-22.9	301	144,163	--	122,357	266,821	--	693	34,415	35,108	301,929	10.5
23.0-24.9	--	146,010	--	153,562	299,572	--	--	34,227	34,227	333,799	11.6
25.0-26.9	--	89,147	--	112,767	201,914	--	--	28,793	28,793	230,707	8.0
27.0-28.9	--	146,031	--	101,912	247,943	--	537	21,616	22,153	270,096	9.4
29.0-30.9	--	95,921	--	100,341	196,262	--	--	10,468	10,468	206,730	7.2
31.0-32.9	--	82,834	--	62,759	145,593	--	--	8,872	8,872	154,465	5.3
33.0-34.9	--	65,030	--	38,009	103,039	--	--	5,985	5,985	109,024	3.8
35.0-36.9	--	61,846	--	32,344	94,190	--	--	8,543	8,543	102,733	3.6
37.0-38.9	--	12,888	--	29,588	42,476	--	--	5,503	5,503	47,979	1.7
39.0-40.9	--	35,148	--	5,381	40,529	--	--	12,171	12,171	52,700	1.8
41.0-42.9	--	13,795	--	6,233	20,028	--	--	4,337	4,337	24,365	.8
43.0-44.9	--	13,404	--	14,541	27,945	--	--	13,830	13,830	41,775	1.4
45.0 and larger	--	39,972	--	--	39,972	--	--	5,632	5,632	45,604	1.6
All diameters	994	1,357,842	2,492	1,231,754	2,593,082	2,020	8,822	283,564	294,406	2,887,488	100.0
Percent	[2]	47.0	0.1	42.7	89.8	0.1	0.3	9.8	10.2	100.0	

[1] Inches at breast height.

[2] Less than 0.1 percent.

Table 16--*Net board-foot volume of sawtimber on commercial forest land by diameter class and species, Haines-Skagway area, Alaska, 1965*

Diameter class[1]	Softwoods					Hardwoods				All species	Percent
	Lodgepole pine	Sitka spruce	Mountain hemlock	Western hemlock	Total	Quaking aspen	Paper birch	Black cottonwood	Total		
	- - - - - - - - - - - - - - - *Thousand board feet, Scribner rule* - - - - - - - - - - - - - - -										
11.0-12.9	132	31,025	400	38,544	70,101	1,246	2,581	5,243	9,070	79,171	3.0
13.0-14.9	234	54,001	429	64,220	118,884	511	1,844	12,029	14,384	133,268	5.0
15.0-16.9	232	78,670	649	85,480	165,031	--	401	23,788	24,189	189,220	7.1
17.0-18.9	--	107,510	830	106,017	214,357	--	1,201	17,786	18,987	233,344	8.8
19.0-20.9	--	109,954	--	124,221	234,175	--	574	18,695	19,269	253,444	9.5
21.0-22.9	259	133,485	--	113,293	247,037	--	603	29,926	30,529	277,566	10.4
23.0-24.9	--	135,194	--	142,187	277,381	--	--	29,763	29,763	307,144	11.6
25.0-26.9	--	82,543	--	104,414	186,957	--	--	25,037	25,037	211,994	8.0
27.0-28.9	--	135,214	--	94,363	229,577	--	467	18,796	19,263	248,840	9.4
29.0-30.9	--	88,816	--	92,908	181,724	--	--	9,102	9,102	190,826	7.2
31.0-32.9	--	76,698	--	58,110	134,808	--	--	7,714	7,714	142,522	5.4
33.0-34.9	--	60,213	--	35,194	95,407	--	--	5,204	5,204	100,611	3.8
35.0-36.9	--	57,265	--	29,948	87,213	--	--	7,429	7,429	94,642	3.6
37.0-38.9	--	11,933	--	27,397	39,330	--	--	4,785	4,785	44,115	1.7
39.0-40.9	--	32,544	--	4,982	37,526	--	--	10,584	10,584	48,110	1.8
41.0-42.9	--	12,773	--	5,771	18,544	--	--	3,772	3,772	22,316	.8
43.0-44.9	--	12,411	--	13,464	25,875	--	--	12,026	12,026	37,901	1.4
45.0 and larger	--	37,012	--	--	37,012	--	--	4,898	4,898	41,910	1.5
All diameters	857	1,257,261	2,308	1,140,513	2,400,939	1,757	7,671	246,577	256,005	2,656,944	100.0
Percent	[2]	47.3	0.1	42.9	90.3	0.1	0.3	9.3	9.7	100.0	

[1] Inches at breast height.

[2] Less than 0.1 percent.

Table 17--*Net volume of sawtimber on commercial forest land by species and log grade, Haines-Skagway area, Alaska, 1965*

Thousand board feet, International 1/4-inch rule

Species	Select and peelers	Log grade 1	Log grade 2	Log grade 3	Log grade 4	All grades except cull	Percent
Softwoods:							
Lodgepole pine	--	--	--	--	3,479	3,479	0.1
Sitka spruce	10,430	8,428	259,930	1,133,662	--	1,412,450	48.9
Mountain hemlock	--	--	--	481	--	481	1/
Western hemlock	6,667	30,615	249,802	952,611	--	1,239,695	43.0
Total	17,097	39,043	509,732	2,086,754	3,479	2,656,105	92.0
Hardwoods:							
Quaking aspen	--	--	--	--	2,723	2,723	.1
Paper birch	--	--	3,201	4,194	225	7,620	.2
Black cottonwood	--	3,280	26,807	176,195	14,758	221,040	7.7
Total	--	3,280	30,008	180,389	17,706	231,383	8.0
All species	17,097	42,323	539,740	2,267,143	21,185	2,887,488	100.0
Percent	0.6	1.5	18.7	78.5	0.7	100.0	

1/ Less than 0.1 percent.

Table 18--*Gross annual growth*1/ *of growing stock on commercial forest land by species and softwoods and hardwoods, Haines-Skagway area, Alaska, 1965*

Species	Thousand cubic feet	Percent of total
Softwoods:		
Lodgepole pine	10	0.2
Sitka spruce	2,271	36.4
Mountain hemlock	15	.2
Western hemlock	2,683	43.0
Total	4,979	79.8
Hardwoods:		
Quaking aspen	50	.8
Paper birch	141	2.3
Black cottonwood	1,067	17.1
Total	1,258	20.2
All species	6,237	100.0

1/ Mortality not deducted.

Table 19--*Gross annual growth of sawtimber on commercial forest land by species and softwoods and hardwoods, Haines-Skagway area, Alaska, 1965*

Species	Thousand board feet	Percent of total
	International 1/4-inch rule	
Softwoods:		
Lodgepole pine	10	1/
Sitka spruce	11,233	40.6
Mountain hemlock	28	.1
Western hemlock	10,760	38.9
Total	22,031	79.6
Hardwoods:		
Quaking aspen	25	.1
Paper birch	128	.4
Black cottonwood	5,502	19.9
Total	5,655	20.4
All species	27,686	100.0
	Scribner rule	
Softwoods:		
Lodgepole pine	8	1/
Sitka spruce	10,401	41.1
Mountain hemlock	26	.1
Western hemlock	9,963	39.4
Total	20,398	80.6
Hardwoods:		
Quaking aspen	21	.1
Paper birch	112	.4
Black cottonwood	4,785	18.9
Total	4,918	19.4
All species	25,316	100.0

1/ Less than 0.1 percent.

Table 20--*Annual mortality of growing stock on commercial forest land by species and softwoods and hardwoods, Haines-Skagway area, Alaska, 1965*

Species	Thousand cubic feet	Percent
Softwoods:		
Lodgepole pine	3	0.1
Sitka spruce	1,699	78.6
Mountain hemlock	--	--
Western hemlock	421	19.5
Total	2,123	98.2
Hardwoods:		
Quaking aspen	8	.4
Paper birch	17	.8
Black cottonwood	13	.6
Total	38	1.8
All species	2,161	100.0

Table 21--*Annual mortality of sawtimber on commercial forest land by species and softwoods and hardwoods, Haines-Skagway area, Alaska, 1965*

Species	Thousand board feet	Percent of total
	International 1/4-inch rule	
Softwoods:		
Lodgepole pine	--	--
Sitka spruce	10,317	81.9
Mountain hemlock	--	--
Western hemlock	2,270	18.0
Total	12,587	99.9
Hardwoods:		
Quaking aspen	--	--
Paper birch	5	.1
Black cottonwood	--	--
Total	5	.1
All species	12,592	100.0
	Scribner rule	
Softwoods:		
Lodgepole pine	--	--
Sitka spruce	9,553	81.9
Mountain hemlock	--	--
Western hemlock	2,102	18.0
Total	11,655	99.9
Hardwoods:		
Quaking aspen	--	--
Paper birch	4	.1
Black cottonwood	--	--
Total	4	.1
All species	11,659	100.0

Table 22--*Annual mortality of growing stock on commercial forest land by causes and softwoods and hardwoods, Haines-Skagway area, Alaska, 1965*

Cause	Softwoods	Hardwoods	Total	Percent
	- - - - - *Thousand cubic feet* - - - - -			
Insects	817	--	817	37.8
Diseases	245	--	245	11.3
Fire	--	--	--	--
Windthrow	483	14	497	23.0
Other	578	24	602	27.9
All causes	2,123	38	2,161	100.0
Percent	98.2	1.8	100.0	

Table 23--*Annual mortality of sawtimber on commercial forest land by cause and softwoods and hardwoods, Haines-Skagway area, Alaska, 1965*

Cause	Softwoods	Hardwoods	Total	Percent
	Thousand board feet, - - *International 1/4-inch rule* - - - -			
Insects	5,193	--	5,193	41.2
Diseases	1,425	--	1,425	11.3
Fire	--	--	--	--
Windthrow	2,807	--	2,807	22.3
Other	3,162	5	3,167	25.2
All causes	12,587	5	12,592	100.0
Percent	99.9	0.1	100.0	
	- *Thousand board feet, Scribner rule* - -			
Insects	4,808	--	4,808	41.2
Diseases	1,320	--	1,320	11.3
Fire	--	--	--	--
Windthrow	2,599	--	2,599	22.3
Other	2,928	4	2,932	25.2
All causes	11,655	4	11,659	100.0
Percent	99.9	0.1	100.0	

Table 24--*Net annual growth*[1] *of growing stock on commercial forest land by species and softwoods and hardwoods, Haines-Skagway area, Alaska, 1965*

Species	Thousand cubic feet	Percent
Softwoods:		
Lodgepole pine	7	0.2
Sitka spruce	572	14.0
Mountain hemlock	15	.4
Western hemlock	2,262	55.5
Total	2,856	70.1
Hardwoods:		
Quaking aspen	42	1.0
Paper birch	124	3.0
Black cottonwood	1,054	25.9
Total	1,220	29.9
All species	4,076	100.0

[1] Net annual growth is gross annual growth with annual mortality deducted.

Table 25--*Average sawtimber volume per acre by stand-size class and local type, Haines-Skagway area, Alaska, 1965*

Stand-size class	Local type			Total
	Spruce-hemlock	Birch	Black cottonwood	
	- - - Thousand board feet, Scribner rule - - -			
Seedlings and saplings	3.3	--	0.1	2.2
Poletimber	5.3	6.9	.7	5.1
Young-growth sawtimber	29.0	--	8.9	21.1
Old-growth sawtimber	27.2	6.7	23.3	26.9
All classes	26.5	6.8	10.2	23.9

Table 26--*Average sawtimber volume per acre by stand-size class and stocking class, Haines-Skagway area, Alaska, 1965*

Stand-size class	Well stocked	Medium stocked	Poorly stocked	All classes
	- - *Thousand board feet, Scribner rule* - -			
Seedlings and saplings	--	2.5	1.6	2.2
Poletimber	5.7	.7	--	5.1
Young-growth sawtimber	28.9	9.3	--	21.1
Old-growth sawtimber	28.9	21.5	18.1	26.9
All classes	27.9	14.9	15.2	23.9

Table 27--*Volume of wood products exported from Haines, Alaska, 1963-67*[1]

Year	Logs	Cants	Total
	Thousand board feet[2]	*Thousand board feet*[3]	*Cubic feet*
1963	1,746	5,471	781,833
1964	3,406	7,479	1,213,166
1965	5,285	10,217	1,746,916
1966	6,492	30,794	3,928,250
1967	5,731	75,750	8,210,166
Total	22,660	129,711	15,880,331

[1] Summarized from table 13, Massie and Haring 1969.

[2] Scribner Decimal C log scale.

[3] Mill tally.

Table 28--*Volume of logs supplied to mills of the Haines-Skagway area, Alaska, and estimated lumber production, 1961-73*

Year	Log volume supplied and source[1]			Lumber tally
	Tongass National Forest	State	Total	
	--Million board feet Scribner rule, Bureau scale--			*Million board feet*
1961	--	0.7	0.7	--
1962	--	6.3	6.3	--
1963	--	7.6	7.6	--
1964	--	18.6	18.6	--
1965	--	16.0	16.0	10.0
1966	--	20.1	20.1	--
1967	8.1	45.4	53.5	80.4
1968	19.9	37.6	57.5	86.4
1969	29.0	35.5	64.5	63.2
1970	17.6	28.8	46.4	54.0
1971	14.5	19.6	34.1	50.2
1972	9.1	16.8	25.9	31.6
1973	27.1	8.0	35.1	44.6

---

[1] Mills of this area obtain an additional, but minor, volume of logs from private land. Logs obtained from private land are usually exported as logs.

LaBau, Vernon J., and O. Keith Hutchison.
1976. Timber supply and use in the Haines-Skagway area, Alaska. USDA For. Serv. Resour. Bull. PNW-67, 44 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Discusses the results of a 1965 forest inventory of 449,300 acres in the Haines-Skagway area. Selected references are used to describe the economy of the area historically and currently. Interpretations and assessments of the timber resource in the continuing economy are made.

KEYWORDS: Forest surveys (Alaska), resources (forest), timber marketing.

LaBau, Vernon J., and O. Keith Hutchison.
1976. Timber supply and use in the Haines-Skagway area, Alaska. USDA For. Serv. Resour. Bull. PNW-67, 44 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Discusses the results of a 1965 forest inventory of 449,300 acres in the Haines-Skagway area. Selected references are used to describe the economy of the area historically and currently. Interpretations and assessments of the timber resource in the continuing economy are made.

KEYWORDS: Forest surveys (Alaska), resources (forest), timber marketing.

LaBau, Vernon J., and O. Keith Hutchison.
1976. Timber supply and use in the Haines-Skagway area, Alaska. USDA For. Serv. Resour. Bull. PNW-67, 44 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Discusses the results of a 1965 forest inventory of 449,300 acres in the Haines-Skagway area. Selected references are used to describe the economy of the area historically and currently. Interpretations and assessments of the timber resources in the continuing economy are made.

KEYWORDS: Forest surveys (Alaska), resources (forest), timber marketing.

LaBau, Vernon J., and O. Keith Hutchison.
1976. Timber supply and use in the Haines-Skagway area, Alaska. USDA For. Serv. Resour. Bull. PNW-67, 44 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Discusses the results of a 1965 forest inventory of 449,300 acres in the Haines-Skagway area. Selected references are used to describe the economy of the area historically and currently. Interpretations and assessments of the timber resources in the continuing economy are made.

KEYWORDS: Forest surveys (Alaska), resources (forest), timber marketing.

Year
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973

from
logs.

The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Developing and evaluating alternative methods and levels of resource management.
3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research are made available promptly. Project headquarters are at:

Fairbanks, Alaska
Juneau, Alaska
Bend, Oregon
Corvallis, Oregon
La Grande, Oregon
Portland, Oregon
Olympia, Washington
Seattle, Washington
Wenatchee, Washington

Mailing address: Pacific Northwest Forest and Range
Experiment Station
P.O. Box 3141
Portland, Oregon 97208

GPO 997-136

The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

The U.S. Department of Agriculture is an Equal Opportunity Employer. Applicants for all Department programs will be given equal consideration without regard to race, color, sex or national origin.

PNW-68

CLEMSON UNIVERSITY LIBRARY

USDA Forest Service
Resource Bulletin PNW-68

September 1976

1974 WASHINGTON TIMBER HARVEST

by

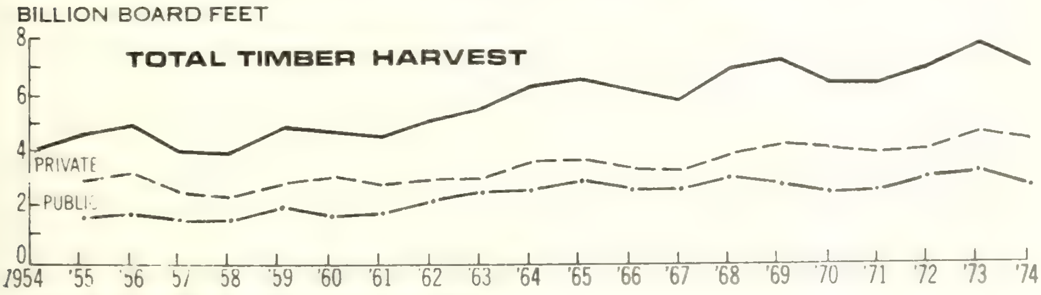
J. D. Lloyd, Jr., *Supervisory Forester*

The 1974 timber harvest of 6.88 billion board feet declined 933 million board feet (11.9 percent) below the record 1973 harvest. Decreases occurred in almost all owner groups. In western Washington the decline was 856 million board feet (13.0 percent). In eastern Washington the decline was 76 million board feet (6.3 percent).

The greater part of this decrease was on public lands where the harvest fell 542 million board feet (17.6 percent) compared to 1973. Harvest on National Forest lands decreased 324 million board feet (20.1 percent) and on State lands 313 million board feet (31.4 percent). The greatest increase was on other public lands (24 million board feet) and other Federal lands (64 million board feet). Indian lands also showed a slight increase of 7 million board feet (1.6 percent). This increase was all in eastern Washington--6.7 percent, whereas western Washington harvest on Indian lands decreased 7.0 percent.

Harvest on private lands decreased 391 million board feet (8.3 percent) to 4.3 billion board feet which is 63 percent of the total harvest for 1974. The decrease in western Washington was 389 million board feet (9.0 percent) whereas eastern Washington declined only 2 million board feet (0.6 percent). Industrial private harvest was down 127 million board feet (3.8 percent) and other private was down 264 million board feet (19.3 percent).

Average stumpage prices per thousand board feet for 1974 on publically owned or managed lands increased $5.36 to $146.18 in western Washington and increased $12.05 to $73.50 in eastern Washington compared to 1973. The volume sold on these lands remained about the same for both years at 2.38 billion board feet.



WASHINGTON TIMBER HARVEST 1954-74

[1] Separate data for public and private not available prior to 1955.

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION

Robert F. Tarrant, *Director*
FOREST SERVICE

P.O.Box 3141, Portland, Oregon 97208
U.S. Department of Agriculture

Timber harvest by ownership in the state of Washington, 1974[1]

(In thousand board feet, Scribner log scale)

Half-state and county	Private						State[2]		Bureau of Land Management[4]		National Forest[4]		Indian lands[4]		Other public[2]		Other Federal[5]		Total production
	Industrial		Other		Total private														
	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	
Western Washington																			
Clallam	209,846	--	62,572	1,049	272,418	1,049	70,797	1,604	--	--	71,585	54	23,548	--	--	--	--	--	441,055
Clark	10,361	--	21,426	51	31,787	51	5,047	653	--	--	--	--	--	--	11	--	--	--	37,549
Cowlitz	613,479	281	33,973	204	647,452	485	59,542	4,564	--	--	15,860	824	--	--	--	--	--	--	728,727
Grays Harbor	242,544	155	72,924	8,944	315,468	9,099	2,625	168	--	--	60,579	5,092	124,712	1,208	14,433	46	--	--	533,430
Island	435	--	20,544	109	20,979	109	--	--	--	--	--	--	--	--	--	--	200	--	21,288
Jefferson	156,483	1,220	31,227	100	187,710	1,320	310,108	4,425	--	--	44,254	827	1,627	--	55	--	275	--	550,601
King	218,763	5	149,566	87	368,329	92	9,409	13	--	--	80,101	2,719	--	--	17,216	--	--	--	477,879
Kitsap	6,562	--	25,039	30	31,601	30	2,447	124	--	--	--	--	986	--	803	--	75	--	36,066
Lewis	512,502	3	69,634	747	582,136	750	15,911	920	--	--	93,314	6,875	--	--	121	--	--	--	700,027
Mason	44,219	884	55,150	2	99,369	886	6,602	108	--	--	81,283	9,715	--	--	--	--	--	--	197,963
Pacific	394,531	--	30,930	189	425,461	189	3,871	155	--	--	--	--	--	--	3,317	--	--	--	432,993
Pierce	192,074	--	62,514	--	254,588	--	20,939	4,558	--	--	6,279	1,487	--	--	--	--	61,607	527	379,985
San Juan	--	--	11,981	137	11,981	137	1	--	--	--	--	--	--	--	--	--	--	--	12,119
Skagit	131,453	--	35,108	69	166,561	69	12,231	161	--	--	49,367	1,954	--	--	847	--	--	--	231,190
Skamania	21,400	--	53,753	290	75,153	290	6,838	82	--	--	262,140	12,583	--	--	--	--	--	--	357,086
Snohomish	53,478	--	109,151	178	162,629	178	22,659	463	--	--	60,587	2,025	--	--	451	--	--	--	248,992
Thurston	76,756	--	67,293	148	144,049	148	6,022	75	--	--	--	--	--	--	570	--	4,253	661	155,778
Wahkiakum	60,264	--	2,692	20	62,956	20	10,489	60	--	--	--	--	--	--	236	--	--	--	73,761
Whatcom	59,144	--	19,258	17	78,402	17	31,235	26	--	--	6,985	205	283	--	4	--	--	--	117,157
Total	3,004,294	2,548	934,735	12,371	3,939,029	14,919	596,773	18,159	--	--	862,334	44,360	151,156	1,208	38,064	46	66,410	1,188	5,733,646
Total live and dead	3,006,842		947,106		3,953,948		614,932		--		906,694		152,364		38,110		67,573		5,733,646
Eastern Washington:																			
Adams	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Asotin	--	--	3,095	19	3,095	19	6,280	--	--	--	3,709	56	--	--	133	1	--	--	13,293
Benton	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chelan	34,730	--	6,140	--	40,870	--	20	--	--	--	34,128	1,155	--	--	930	--	--	--	77,104
Columbia	500	--	1,392	--	1,892	--	1,912	--	--	--	6,643	30	--	--	80	--	--	--	10,557
Douglas	--	--	407	--	407	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ferry	3,885	--	3,990	181	7,875	181	1,833	--	--	--	37,531	--	93,757	2,138	--	--	--	--	143,315
Franklin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Garfield	--	--	1,097	--	1,097	--	--	--	--	--	5,966	492	--	--	--	--	--	--	7,555
Grant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Kittitas	54,273	40	6,717	128	60,990	168	8,331	173	--	--	61,310	1,935	--	--	665	325	--	--	134,397
Klickitat	50,486	2,815	13,639	6	64,125	2,821	14,104	134	--	--	10,914	488	7,856	2,508	--	--	--	--	102,950
Lincoln	270	--	7,777	--	8,047	--	556	6	--	--	--	--	--	--	--	--	--	--	8,609
Okanogan	495	--	22,937	--	23,432	--	17,815	228	--	--	93,693	1,253	19,001	--	--	--	--	--	155,422
Pend Oreille	32,423	445	20,295	80	52,718	525	3,505	20	--	--	32,359	245	103	--	60	--	--	--	89,535
Spokane	2,920	--	20,224	--	23,144	--	159	--	--	--	--	--	--	--	330	--	--	--	23,633
Stevens	40,782	--	45,478	85	86,260	85	9,253	848	--	--	19,194	--	20,376	--	300	--	2,239	--	138,555
Walla Walla	--	--	676	--	676	--	--	--	--	--	2,073	42	--	--	--	--	--	--	2,791
Whitman	--	--	974	--	974	--	--	--	--	--	--	--	--	--	--	--	--	--	974
Yakima	2,006	698	874	--	2,880	698	4,886	21	--	--	66,614	3,039	92,275	62,063	1,052	--	--	--	233,528
Total	222,770	3,998	155,712	499	378,482	4,497	68,654	1,430	--	--	374,135	8,735	233,368	66,709	3,550	826	2,239	--	1,142,625
Total live and dead	226,768		156,211		382,979		70,084		--		382,870		300,077		4,376		2,239		1,142,625
Total Washington	3,227,064	6,546	1,090,447	12,870	4,317,511	19,416	665,427	19,589	--	--	1,236,469	53,095	384,524	67,917	41,614	872	68,649	1,188	6,876,271
Total live and dead	3,233,610		1,103,317		4,336,927		685,016		--		1,289,564		452,441		42,486		69,837		6,876,271

---

[1] Includes volume in logs, poles, piling, shingles, bolts, etc.

[2] Compiled by Washington State Department of Natural Resources.

[3] Includes snags and down material existing prior to initial logging.

[4] Compiled by agencies, U.S. Bureau of Land Management, U.S. Forest Service, U.S. Bureau of Indian Affairs.

[5] Includes lands logged under jurisdiction of U.S. Department of Interior--Bonneville Power Administration, National Park Service, Bureau of Sport Fisheries and Wildlife; and Department of the Army.

Prepared by Forest Resources Evaluation Project, Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of

Keywords: Production statistics, Washington.

USDA Forest Service
Resource Bulletin PNW-69

December, 1976

LIBRARY
JUN 22 1977
SCI. TECH. & AGR. DIV.

1975 OREGON TIMBER HARVEST

by

J. D. Lloyd, Jr., *Supervisory Forester*

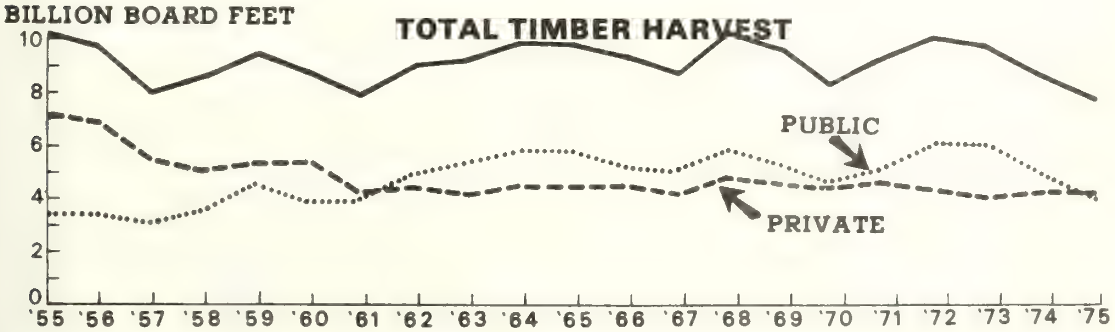
The 1975 Oregon timber harvest declined to its lowest level since 1961 with a harvest of 7.37 billion board feet, 991 million board feet (11.9 percent) below the 1974 harvest. The harvest was down in both western Oregon (823 million board feet, 13.2 percent) and eastern Oregon (168 million board feet, 7.7 percent). For the first time since 1961, the harvest on private lands exceeded harvest on public lands, making up 51.3 percent of the total.

Total public harvest in 1975 fell to its lowest level since 1961. Compared with 1974, total public cut in western Oregon was down 914 million board feet (28.4 percent) and in eastern Oregon 36 million board feet (2.7 percent). Harvest on National Forests decreased 502 million board feet (15.9 percent) and on Bureau of Land Management land, 399 million board feet (38.9 percent). Harvest on State land declined 66 million board feet (29.0 percent). There was a combined increase of 17 million board feet (13.5 percent) on other public, other Federal, and Indian lands.

Harvest on private lands decreased 41 million board feet (1.1 percent). Forest industry harvest increased 181 million board feet (6.9 percent) in western Oregon and decreased 11 million board feet (1.8 percent) in eastern Oregon. Harvest on other private lands was down 90 million board feet (26.4 percent) in western Oregon and 121 million board feet (51.7 percent) in eastern Oregon.

In western Oregon the average stumpage price of timber sold on publicly owned or managed lands declined for the first time since 1970 to $136.72 per thousand board feet (20 percent below 1974). The price decreased for the first time since 1971 in eastern Oregon to $35.72 per thousand board feet (54 percent below 1974). Volume sold on these lands has remained about the same for the last 5 years at 4.9 billion board feet.

OREGON TIMBER HARVEST 1955-75



PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION

Forest Service
U.S. Department of Agriculture

P.O. Box 3141
Portland, Oregon 97208

Timber harvest by ownership in the State of Oregon, 1975[1]

(In thousands of board feet, Scribner log scale)

Half-State and county	Private[2]			Bureau of Land Management[3]	National Forest[4]	Indian[5]	Other Federal[2]	State[6]	Other public[2]	Total
	Forest industry	Other	Total							
Western Oregon:										
Benton	46,952	2,204	49,156	17,594	14,925	--	--	4,304	1,546	87,525
Clackamas	94,490	5,156	99,646	10,903	149,267	3,033	239	7	256	263,351
Clatsop	183,468	5,844	189,312	--	--	--	--	27,668	389	217,369
Columbia	89,866	6,287	96,153	54	--	--	--	1,101	756	98,064
Coos	318,470	17,511	335,981	99,559	22,906	--	--	35,637	4,216	498,299
Curry	62,032	14,172	76,204	9,221	69,621	--	--	230	--	155,276
Douglas	621,255	42,681	663,936	178,311	304,125	--	--	13,281	2,587	1,162,240
Hood River	1,926	6,238	8,164	--	40,345	--	--	--	2,570	51,079
Jackson	140,933	13,767	154,700	71,474	97,648	--	--	--	--	323,822
Josephine	3,319	7,173	10,492	37,682	51,474	--	--	1,269	4,165	105,082
Lane	479,727	31,849	511,576	98,844	397,630	--	--	10,957	17	1,019,024
Lincoln	177,905	11,920	189,825	16,521	71,079	--	--	9,072	--	286,497
Linn	371,975	60,230	432,205	26,387	196,442	--	--	9,173	--	664,207
Marion	14,708	3,524	18,232	6,321	28,790	--	246	6,460	--	60,049
Multnomah	4,139	1,086	5,225	--	37,595	--	77	--	--	42,897
Polk	54,000	3,074	57,074	7,839	--	--	--	5,351	--	70,264
Tillamook	101,722	5,489	107,211	18,502	22,773	--	299	34,301	--	183,086
Washington	14,933	8,255	23,188	--	--	--	--	1,054	211	24,453
Yamhill	34,162	3,205	37,367	10,242	4,553	--	299	--	2,117	54,578
Total	2,815,982	249,665	3,065,647	609,454	1,509,173	3,033	1,160	159,865	18,830	5,367,162
Eastern Oregon:										
Baker	--	4,349	4,349	--	58,622	--	--	--	--	62,971
Crook	1,284	1,519	2,803	3,192	68,509	--	--	--	--	74,504
Deschutes	14,336	906	15,242	--	60,169	--	--	--	--	75,411
Gilliam	--	--	--	--	--	--	--	--	--	--
Grant	20,515	4,299	24,814	176	213,703	--	--	--	--	238,693
Harney	--	1,504	1,504	16	66,555	--	--	--	--	68,075
Jefferson	19,829	--	19,829	--	50,135	30,267	--	--	--	100,231
Klamath	264,741	50,357	315,098	9,648	208,623	--	--	--	--	533,369
Lake	187,413	16,397	203,810	--	104,112	--	--	--	--	307,922
Malheur	--	599	599	--	3,070	--	--	--	--	3,669
Morrow	7,624	4,754	12,378	--	21,224	--	--	--	--	33,602
Sherman	--	--	--	--	--	--	--	--	--	--
Umatilla	18,523	3,660	22,183	1,321	62,717	--	--	--	--	86,201
Union	23,355	6,826	30,181	2,106	77,294	--	--	--	--	109,581
Wallowa	19,460	10,909	30,369	--	56,538	--	--	--	--	86,907
Wasco	--	2,611	2,611	--	79,674	89,322	--	--	--	171,607
Wheeler	25,675	4,359	30,034	203	20,563	--	--	--	--	50,800
Total	602,755	113,029	715,784	16,662	1,151,508	119,589	--	--	--	2,003,543
Total Oregon	3,418,737	362,694	3,781,431	626,116	2,660,681	122,622	1,160	159,865	18,830	7,370,705

[1] Includes volume removed as logs and poles and piling but not volume removed from woodcutting operations.

[2] Compiled by Oregon State Department of Revenue.

[3] Compiled by U.S. Bureau of Land Management. Beginning with 1974, volumes for western Oregon are adjusted from short log to long log by a factor of 0.89.

[4] Compiled by U.S. Forest Service, Region 6.

[5] Compiled by U.S. Bureau of Indian Affairs.

[6] Compiled by State Forester.

Prepared by Forest Resources Evaluation Project, Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Portland, Oregon.

Keywords: Production statistics, Oregon.

PNW-70

USDA FOREST SERVICE RESOURCE BULLETIN PNW-70
1977

THE VALE RANGELAND REHABILITATION PROGRAM: THE DESERT REPAIRED IN SOUTHEASTERN OREGON

HAROLD F. HEADY
JAMES BARTOLOME

PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION
FOREST SERVICE · U.S. DEPARTMENT OF AGRICULTURE
PORTLAND, OREGON

Harold F. Heady is Professor of Range Management and James Bartolome is Lecturer in Range Management at the Department of Forestry and Conservation, University of California, Berkeley.

Acknowledgments

This study was principally funded by the United States Department of the Interior, Bureau of Land Management. The objectives of the study were developed jointly by the Bureau of Land Management, USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, and the authors.

The authors wish to express their appreciation to personnel of both the Vale, Oregon, District and others in the Bureau of Land Management and to the Pacific Northwest Forest and Range Experiment Station. Many persons in both organizations enthusiastically contributed to this study. This report will be used as a case study in the United Nations Environment Program on Desertification.

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife -- if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

PROTECT

Use Pesticides Safely
FOLLOW THE LABEL
U S DEPARTMENT OF AGRICULTURE

Mention of products by name does not constitute and endorsement by the U.S. Department of the Interior or the U.S. Department of Agriculture.

THE VALE RANGELAND REHABILITATION PROGRAM: THE DESERT REPAIRED IN SOUTHEASTERN OREGON

Reference Abstract

Heady, Harold F., and James Bartolome.
1977. The Vale rangeland rehabilitation program: The desert repaired in southeastern Oregon. USDA For. Serv. Resour. Bull. PNW-70, 139 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Discusses the initiation, execution, and outcome of an 11-year program of range rehabilitation on public domain lands in southeastern Oregon. Initiated primarily to benefit the livestock industry, the investment of $10 million in range improvements also profoundly affected other multiple uses. The analysis of this large and successful program should serve as a useful guide for monitoring other range programs.

KEYWORDS: Range management, range development, rehabilitation, revegetation, environment, economics (rangeland).

RESEARCH SUMMARY

Resource Bulletin PNW-70

1977

This report evaluates the large-scale rangeland rehabilitation program in the Vale, Oregon, District of the Bureau of Land Management. Sagebrush in combination with two grasses, the native perennial bluebunch wheatgrass and the introduced annual cheatgrass, dominates the vegetation on 90 percent of the 60- by 175-mile (100- by 180-km) area of the district. Cold winters and dry summers characterize the climate; annual precipitation averages from 7 to 12 inches (180 to 300 mm). About 24,000 persons live in the district but they are concentrated in a small region of irrigated croplands. More than half the 419 ranchers in the district had grazing permits on Federal lands in 1975.

The history of livestock use and human settlement, beginning with the arrival of the fur trappers in the early 1800's, is discussed. Major impacts came from travelers along the Oregon Trail, mining after 1863, and exploitive livestock grazing and homesteading from 1880 until 1934. Passage of the Taylor Grazing Act in 1934 initiated management of the public domain lands. The destruction of the vegetation and soil was related to the types of use. The nature of the climax vegetation, the pattern of destruction, and present range condition are inferred.

Congress appropriated approximately $10 million over an 11-year period beginning in 1963 to halt erosion, stabilize the livestock industry, and benefit other land uses. The money was used to control brush on 506,000 acres (205,000 ha) to seed 267,000 acres (108,000 ha) to desirable forage species, and to build over 2,000 miles (3 330 km) of fence, 1,600 water developments, and 463 miles (741 km) of pipelines. Supervision and management of the land uses were large parts of the Vale Program.

The major sagebrush control practices used either disk plows or aerially applied 2,4-D. Absence of native forage species necessitated seeding of introduced species, primarily crested wheatgrass. Attempts at reseeding without site preparation usually failed. Burning as a land treatment was not seriously considered.

Extensive sampling of treated areas revealed that most attempts at land rehabilitation succeeded. Treatments reduced brush, yet rarely were all brush plants killed. Reinvasion of sagebrush occurred in almost all areas, especially shortly after treatment. Where perennial grass stands were dense, cheatgrass was usually absent, and big sagebrush only reinvaded to about 25 percent cover. Under proper management, stands with brush no more than a quarter of the total cover should last indefinitely.

Livestock management formed an integral part of the Vale Program from its beginning. Currently, several hundred pastures are used in a myriad of different patterns of seasonal and rotational use. Of 144 pastures examined, 15 percent were grazed at the same time every year; 33 percent were rotated during the growing season and every year after seed had ripened. Systems emphasized deferment until seed ripening rather than no grazing for a whole year. The original plan to use crested wheatgrass primarily for the spring turnout pastures gradually changed during the course of the Vale Program. Crested wheatgrass seedings are now managed in the same patterns as the native bluebunch wheatgrass range. The Vale Program has increased the district's estimated grazing capacity from 285,000 animal unit months (AUM's) in 1962 to 438,000 AUM's in 1975. As only 8 percent of the total district was treated with brush control and seeding, most of the increase in grazing capacity resulted from improvement of native range.

Use values other than for livestock increased because of the project. The nearly 2,500 wild horses are rapidly increasing. Pronghorn antelope and bighorn sheep have increased, if not because of improved range conditions, at least along with the rehabilitation. Other wildlife species exhibited varied responses in relation to their particular habitat requirements, but none seems to have been damaged permanently by the land treatment. Water developments for livestock benefited waterfowl, and new fisheries were established. Range restoration, stimulated by the need for livestock production and made necessary by past abuses in livestock management, favorably served other range users as well. Except for soil damage from off-road vehicles, accelerated erosion has been essentially eliminated.

An economic analysis of the overall program reveals that at the current $1.51 fee for an AUM costs exceed benefits by about $5 million. At the $3 market value of an AUM in the region, costs exceed benefits to livestock by only $500,000. Many continuing costs are associated with upkeep of the physical improvements, especially water developments. Users, such as hunters, campers, rockhounds, and fishermen, have benefited from the project to an amount which probably exceeds the difference between livestock income and costs. We believe the nonmarket values of the Vale Program to society, including restoration of abused and exploited natural resources, exceed even the $5 million not covered by livestock grazing at the $1.51 fee per AUM.

Contents

Page

INTRODUCTION 1
THE VALE DISTRICT 2
  Location and Extent 2
  Physiography 2
  Climate 2
  Soils 8
  Vegetation 8
DEMOGRAPHY AND ECONOMIC PROFILE OF MALHEUR COUNTY, OREGON 20
  Population 20
  Economy 20
HISTORY OF LAND USE AND ITS EFFECTS 22
  Prior to 1934 22
  1934 to 1962 24
  Vegetation before Grazing by Domestic Animals 26
  Destruction of Cover 28
  Pattern of Range Deterioration 28
  Wild Animals 1776-1962 30
  Range Rehabilitation Prior to 1962 32
THE VALE REHABILITATION PROGRAM 36
  The Original Proposal 36
  Passage Through Congress 37
  Budget 37
  Land Treatment Projects 37
THE RANGELAND REHABILITATION OPERATION 43
  District Planning 43
  Site Selection 44
  Brush Control 46
  Seeding 49
  Fire 52
  Water Developments, Fences, and Roads 55
  Errors and Lack of Compliance with Contracts 59
  Continued Upkeep After the Vale Program Ended 61
GRAZING MANAGEMENT 64
  Permitted Grazing Load 64
  Season of Grazing Use 67
  Grazing Systems 67
  Control of Animal Distribution and Management. 73
  Monitoring of Grazing. 74
VEGETATIONAL CONDITION IN 1975 75
  Methods. 75
  Untreated Areas. 76
  Brush Control and Seeding Treatments 80
  Big Sagebrush Reinvasion 87
  Summary Comments on Vegetation in 1975 93
MULTIPLE USES AND RELATIONSHIPS IN THE VALE DISTRICT 96
  Livestock. 96
  Wild Horses 97
  Wildlife and Fisheries 101
    Mule Deer. 103
    Pronghorn Antelope 106
    Bighorn Sheep. 108

        Rocky Mountain Elk 108
        Blacktailed Jackrabbits 108
        Chukar Partridge 110
        Sagegrouse 110
        Quail. 112
        Waterfowl 112
        Ground Squirrels 112
        Raptorial Birds 114
        Other Predators 114
        Fisheries. 115
        An Overall View 115
    Threatened and Endangered Species 117
    Recreational Uses 119
    National Heritage 123
    Occupancy 124
    Mining 124
    Watershed 124
COSTS AND BENEFITS OF THE VALE DISTRICT PROGRAM 127
PUBLIC OPINION 133
PLANT NAMES 136
PUBLISHED AND UNPUBLISHED REFERENCES 137

Introduction

This report evaluates a large-scale rangeland rehabilitation program on lands administered by the Vale, Oregon, District of the Bureau of Land Management (BLM). Analysis goes beyond a biological-physical characterization because the program cannot be fully understood without knowledge of the many factors surrounding its initiation. The report presents the history of land use in the district, some practical politics of land management, multiple use relationships, impacts of range rehabilitation on many parts of the rangeland ecosystem, community reactions to the program, and economics of rangeland rehabilitation. The Vale Program exemplifies these national land use issues. Program evaluation should be useful in a broader context than just Malheur County, Oregon. We have two principal objectives in this report: (1) to make the lessons learned in the Vale Program available for land rehabilitation programs elsewhere and (2) to present a large and practical example of successful cooperation among land users of different kinds, including their supporting political and social institutions.

A resource management program, such as the Vale Program, aims to accomplish good deeds. The kinds of products which are good, the quantities of each, and where they arise may be indicated in the plans for the program; but society, economics, and political necessities change. Competition and controversies develop, so the managers of public lands must answer changing multiple use questions as time goes on. The public now asks for more consideration of environmental impacts, deeper analysis of alternatives in land use, better informed resource allocation, and more multiple resource planning on a long-term basis than was considered when the program started. Congress has established by law a long-term planning process in the Forest and Rangeland Renewable Resources Act of 1974. Although the program planning part of that act does not apply to the lands administered by BLM, additional resource planning on those lands will probably be required. This case history of the Vale Program should be helpful in future planning efforts both locally and on other districts.

The Vale Program started without full inventory and analysis of the landscape conditions. Little or no continued monitoring of effects was done beyond estimates and evaluations needed for further on-the-spot decisions. Therefore, the data base for this report varies in accuracy and quantity. File materials, mimeographed reports, opinions of persons interviewed, and early photos have been used. Data were obtained from other agencies and we collected considerable measurements of vegetation in the many treated areas. Therefore, our conclusions are based on a variety of sources and impressions gained on a part-time basis extending from April 1975 to September 1976.

Several terms are defined briefly to clarify their use within this work. Rangeland refers to the land and its resources of soil, vegetation, and wild animals. Rangeland management means land management for all purposes. Livestock management principally concerns the movement and husbandry of domestic animals. Wildlife includes game, fish, and other wild animals. Animal unit month (AUM) refers to a mature cow, with or without a calf, grazing for 1 month, or its equivalent in other kinds and classes of livestock. Any cow or horse over 6 months old is counted as an animal unit (AU) by BLM. We use "program" throughout to encompass the whole operation and "project" to be specific, as the "Chicken Creek seeding project."

The Vale District

LOCATION AND EXTENT

The Vale District of the Bureau of Land Management occupies the southeastern corner of Oregon, approximately within latitudes 42 and 44 degrees north, and longitudes 117 and 118 degrees west. The boundaries of Malheur County, Oregon, nearly coincide with those of the district. In addition, a small area in Idaho southwest of the Owyhee River and another piece to the south in Nevada are included in the district. At the time the Vale Program was begun in 1962, the district enclosed 6.5 million acres (2.6 million ha). Several boundary adjustments resulted in a shift in location and a slight reduction in area. The Vale District forms a rough rectangle approximately 175 by 60 miles (280 by 100 km) (fig. 1). To avoid extensive redrafting, the maps presented in this report are based on boundaries as they existed in the 1960's.

PHYSIOGRAPHY

As shown in figure 2, elevations in the district range from 2,000 to nearly 8,000 feet (600 to 2 400 m). The higher elevations in the Trout Creek Mountains to the southwest and the upper reaches of Bully Creek in the northwest drain toward the Snake River along the northeastern edge of the district. Main drainages are the Malheur River which flows from the west and the Owyhee River which flows northward through the district from its origins near the corner of Oregon, Idaho, and Nevada.

The most extensive land form is a gently sloping to rolling lava plateau with elevations above 4,000 feet (1 200 m). This plateau has been extensively dissected into canyons with vertical cliffs by branches of the Owyhee River and Succor Creek (fig. 3) (Kittleman 1973). Mesas of several thousand acres, the remnants of earlier plateaus, are important as topographyic features and as management units. The variety of physiographic prominences such as the rugged Owyhee Breaks along the east side of the Owyhee Reservoir and the Rome Colosseums, Mahogany Mountain, and Three Finger Rock contrast with the broad flat expanse of Barren Valley in the west-central region of the district. Numerous closed basins indicate the existence of ancient lakes. Recent lava flows, some probably between 500 and 1,000 years of age, in the central region still remain devoid of soil and vegetation. The Jordan craters and caves in the lava flows appear as if they were formed only yesterday. The older lava has varying degrees of soil development. Basaltic and rhyolitic lava and tuffs, ranging in age from Miocene to Recent, underlie extensive areas in the district.

CLIMATE

The semiarid climate of the Vale District is in a transition zone between continental and Pacific coastal types, with wide variations in rainfall and temperature between seasons. The district typifies the Great Basin region and is called a cold desert. Most of the district receives an average of 7 to 12 inches (180 to 300 mm) of precipitation annually (fig. 4). Average annual precipitation strongly correlates with elevation, but only the higher mountains receive more than 15 inches (380 mm).

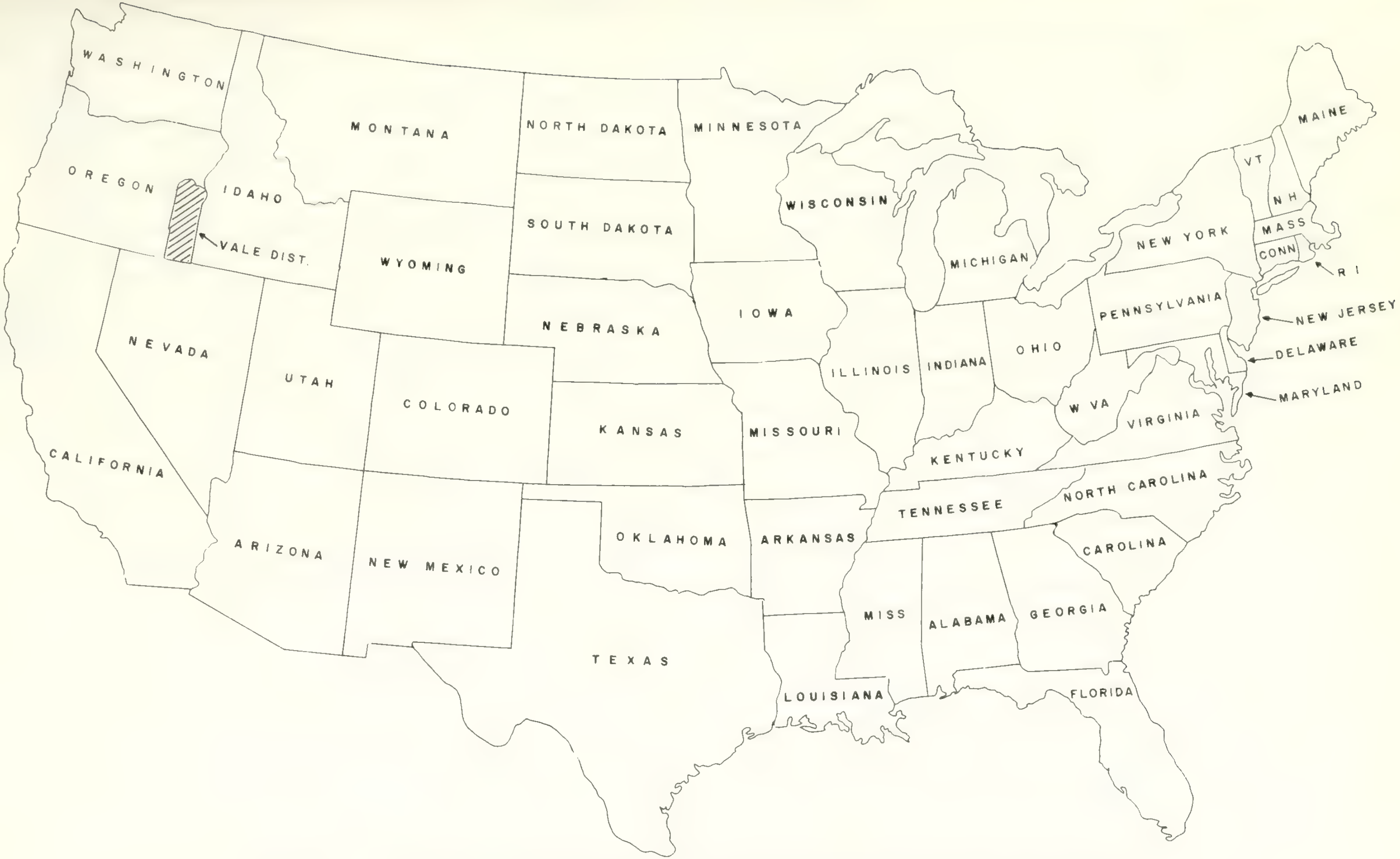


Figure 1.--The Vale District occupies the southeastern corner of Oregon.

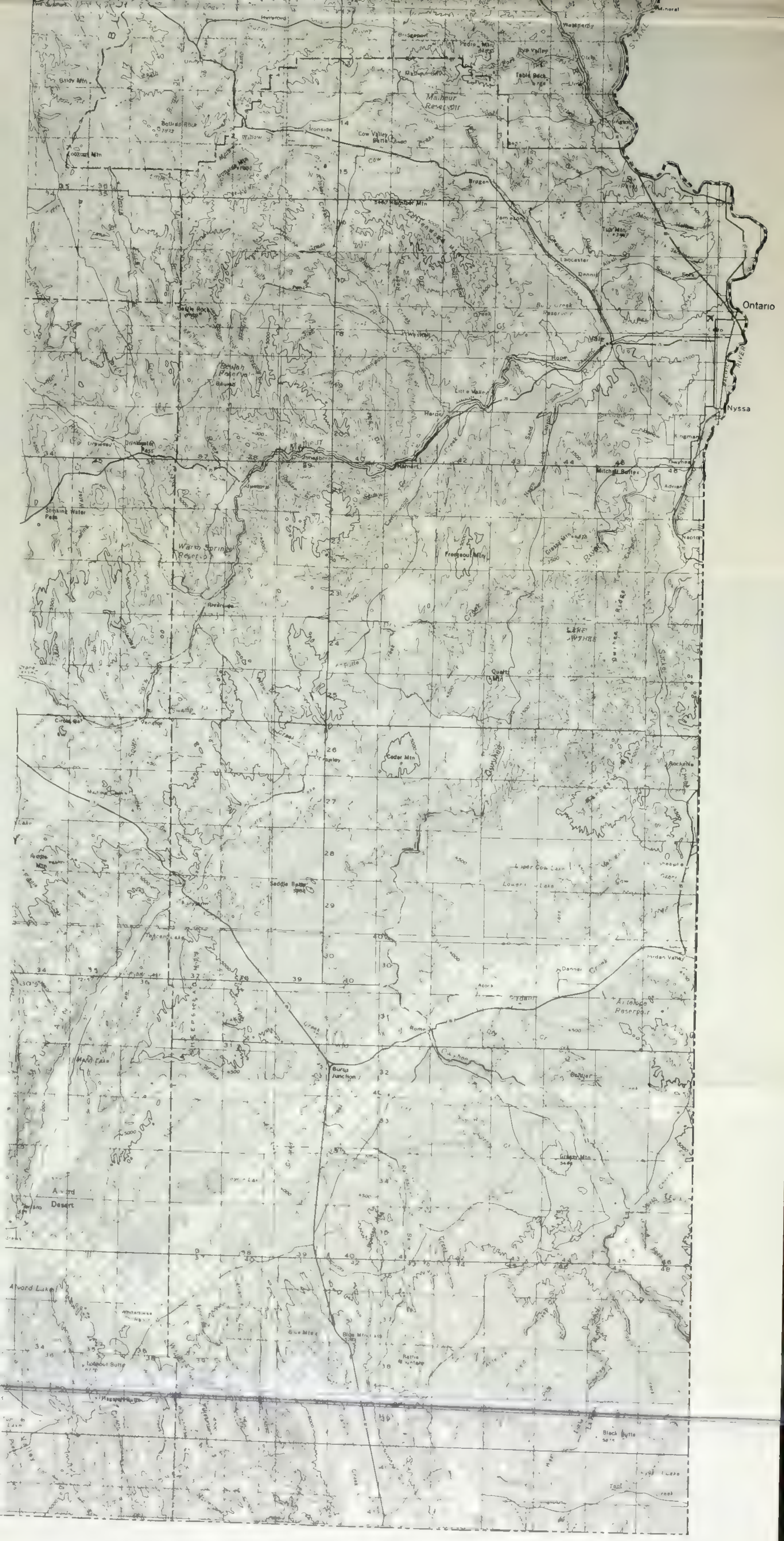


Figure 2.--Physical, topographic, cultural features, and land ownership of the Vale District

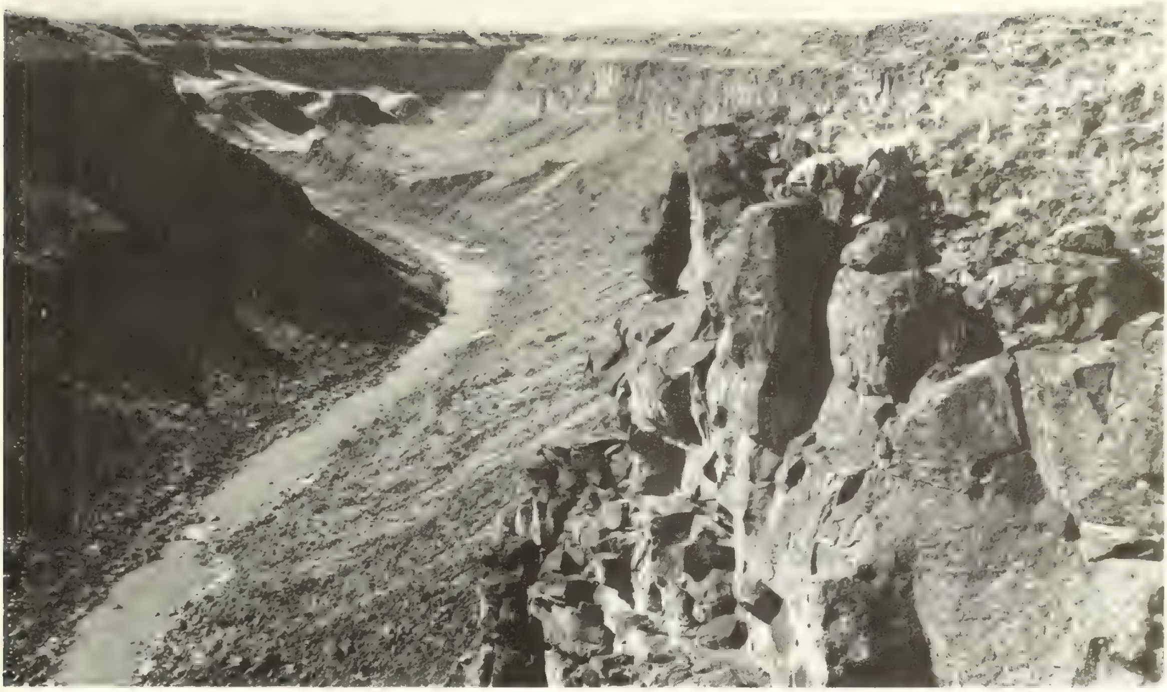


Figure 3.--The Owyhee River and its branches cut this and other canyons across the Vale District (Bureau of Land Management photo).

Most precipitation falls during the winter (November-March) in the form of snow; however, May is the wettest month of the year (fig. 5). Thunderstorms contribute rain in early summer, but significant moisture for plant growth comes almost entirely in winter precipitation. At Vale, Oregon, the crop year precipitation varied as much as 70 to 140 percent of the 22-year average of 9.3 inches (236 mm) from 1955 through 1976 (table 1). During the 11 years (1962-72) of major vegetational manipulation in the Vale District program, 7 received more than average precipitation and only 1 year was exceptionally dry in the spring.

Temperatures vary greatly by season and are markedly influenced by elevation. Danner, Oregon, at 4,000-foot (1 200-m) elevation near the center of the district, showed a range of mean monthly temperatures from 68.5 °F in July to 25.6 °F in January (20.3 to -3.7 °C). All mean monthly temperatures for November through March were below 40 °F (4.6 °C) (fig. 5).

The cold winters and lack of summer moisture limit the actual growing season to a short period in spring and early summer. The frost-free season is less than 90 days in areas above 4,500-foot (1 375-m) elevation, which limits agriculture to the harvesting of hay in valleys south of the Malheur River. The low-elevation lands along the Malheur and the Snake Rivers produce sugar beets, onions, potatoes, feed grains, hay, and many other crops under irrigation. Grazing use is restricted by the ephemeral nature of watering places as well as the short green-feed season. Little permanent, undeveloped water exists over much of the district, especially outside of patented land. Water development for livestock has been a major range management practice.

SOILS

Soils of the Vale District fall into five of the great soil groups (fig. 6). Of the mapped groups, only three, numbers 2, 3, and 5, are of major importance on rangeland.

Group 1 soils are deep alluvial sierozem calcisols which underlie the irrigated cropland in several areas of the Vale District, mainly in the northeast on low-elevation terraces and flood plains of the Snake and Malheur Rivers. These soils are only used as grazing land where they cannot be irrigated.

Group 2 soils of the sierozem desert group were formed from alluvial deposits. They constitute a significant portion of the rangeland soils on the Vale District. These soils occur on old fans and as high terrace remnants. They are loamy, well-drained soils with cemented hardpans about 10-20 inches (250-500 m) below the surface. The texture varies from gravelly loam to silt loam. A coarse gravel and cobble pavement characterizes many soils of the group. Native vegetation is dominated by big sagebrush (*Artemisia tridentata*),[1] low sagebrush (*Artemisia arbuscula*), bud sage (*Artemisia spinescens*), rabbitbrush (*Chrysothamnus* spp.), saltbush (*Atriplex* spp.) needlegrasses (*Stipa* spp.), Sandberg bluegrass (*Poa secunda*), and squirreltail (*Sitanion hystrix*) (Lovell et al. 1969).

Soils in Groups 3 and 5 differ primarily in type of volcanic origin; Group 3 soils developed from rhyolites and Group 5 from basalts of Miocene age. Soils on both are lithosols or brown chestnuts, and they occur on gently sloping to rolling lava plateaus. Typically these soils are fine loamy to clayey, light colored, very stony, and usually less than 20 inches (0.5 m) above bedrock. Often a thin silica-cemented hardpan is present just above bedrock. Areas of Group 3 and 5 soils with 18 inches (45 cm) or more of soil depth are major areas for rangeland reseeding. Native vegetation is bluebunch wheatgrass (*Agropyron spicatum*), Sandberg bluegrass, big sagebrush, and low sagebrush. Idaho fescue (*Festuca idahoensis*) is present on more mesic sites (Lovell et al. 1969).

Soils of Group 4 are lithosols confined to a small area in the extreme northwest of the district. They developed from granitic parent material and have little potential for range production.

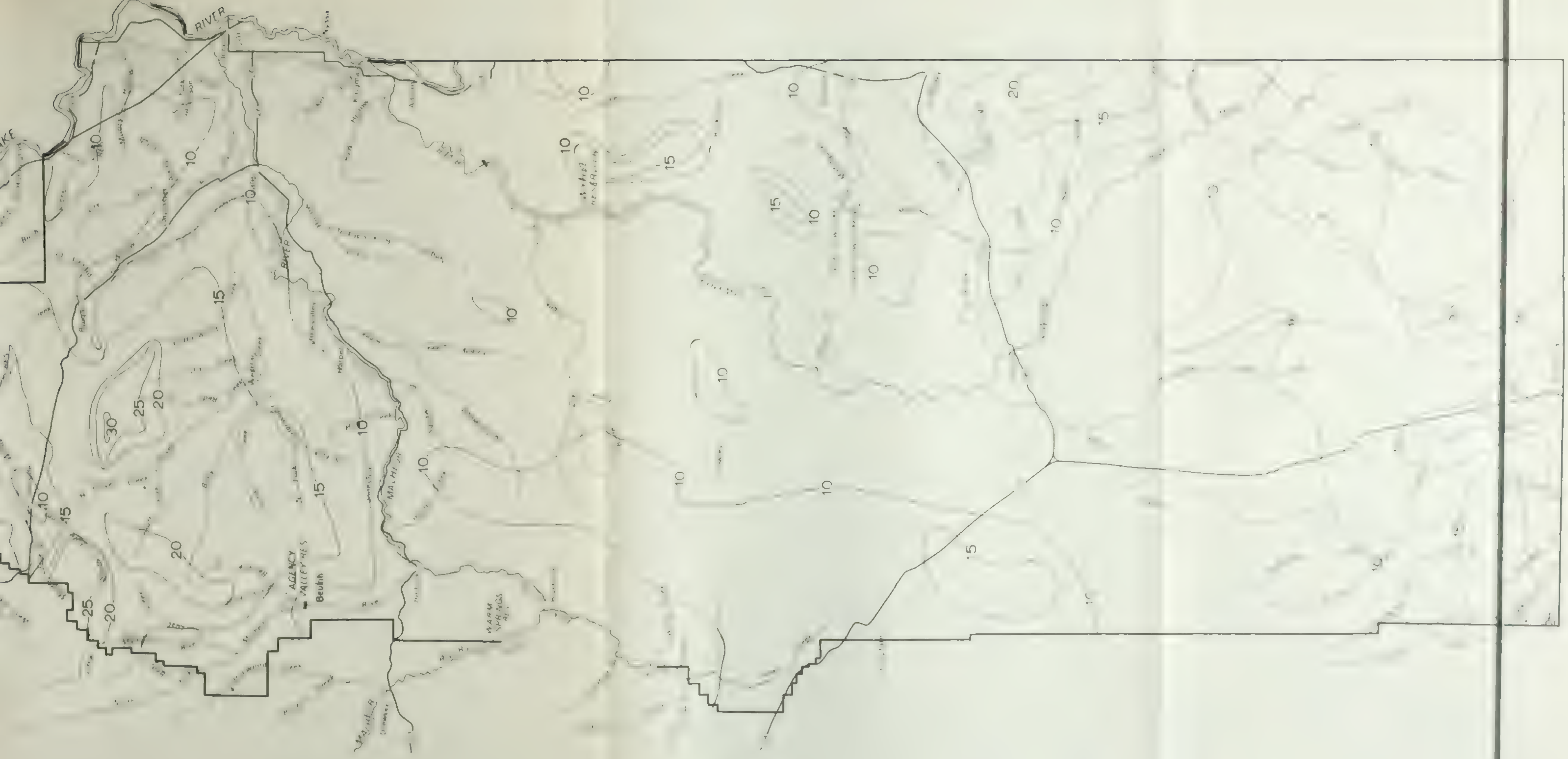
VEGETATION

Brush dominates Vale District vegetation (table 2). Of the six vegetational types in figure 7, big sagebrush is by far the most common (fig. 8). The species occurs in all the other types. Vegetation of the whole district has a strong shrub component.

The map in figure 7 was generalized from Range Reconnaissance Surveys made in 1963-64, shortly after the rehabilitation program was started. The type numbers and names follow the system of standard symbols used in that survey.

---

[1] Common and scientific names follow Hitchcock and Cronquist (1973).


RIVER
AKE
RIVER
AGENCY
VALLEY RES
Beulah
WARM SPRINGS
10
15
20
25
30

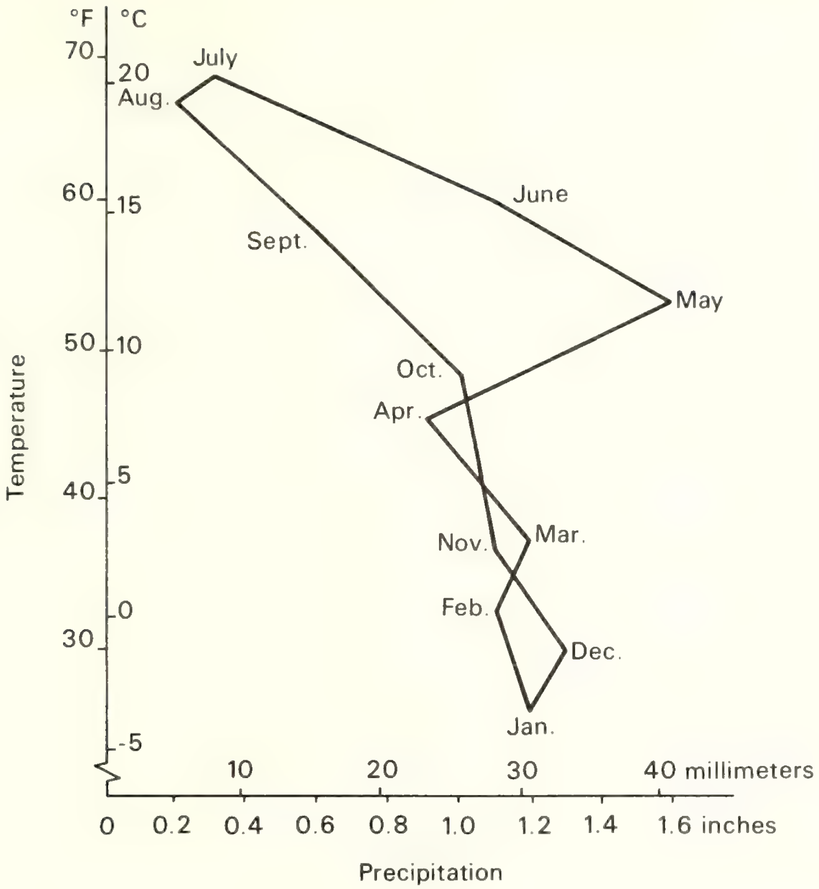


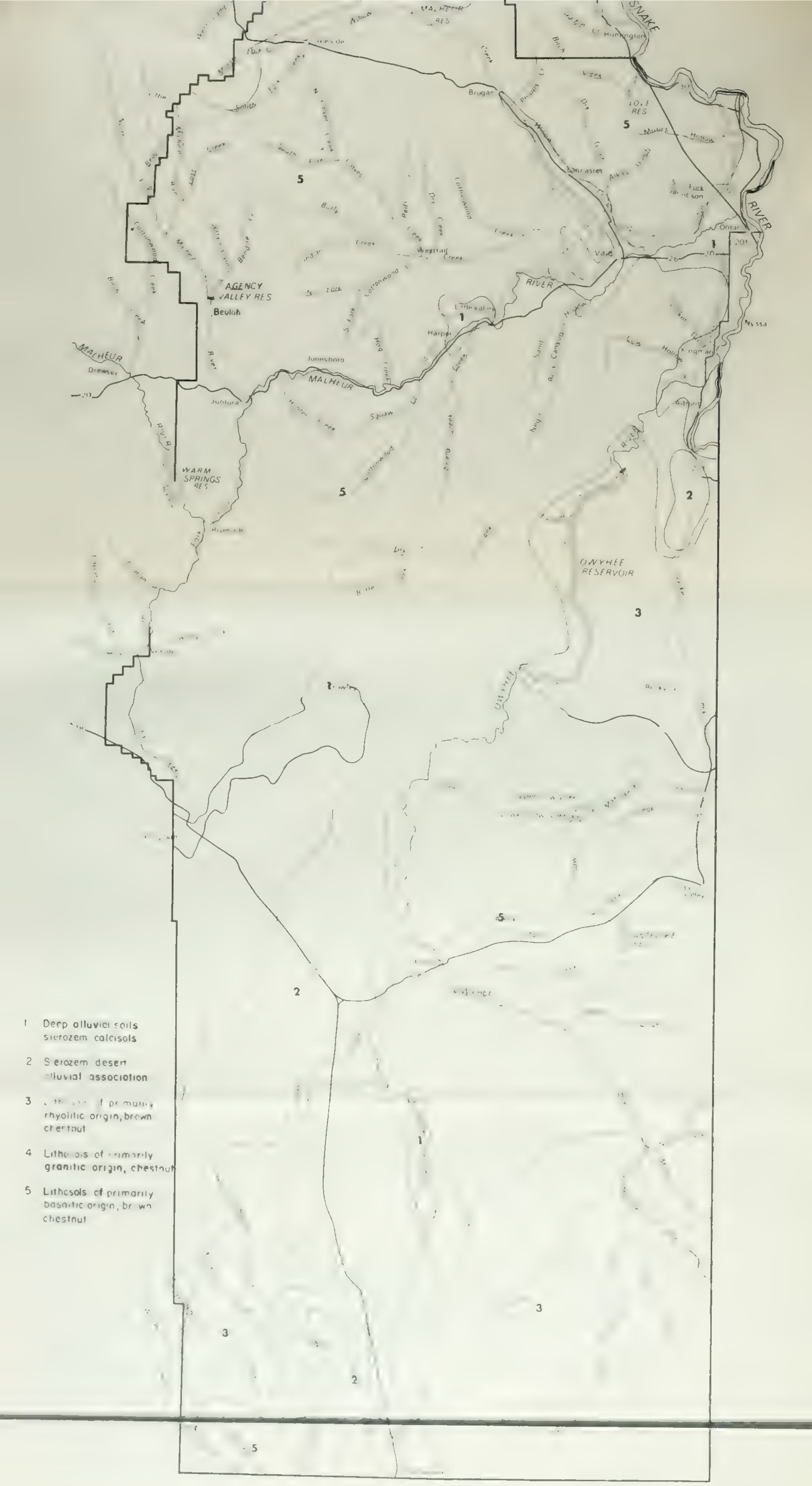
Figure 5.--20-year mean monthly temperature and precipitation for the Danner, Oregon, Weather Station, 1944-63. Danner is approximately 15 miles (24 km) west of Jordan Valley. Yearly mean was 11.5 inches (290 mm) (U.S. Weather Bureau. Climatological Data, Oregon).

Table 1--*Precipitation at Vale, Oregon, on a crop year basis, July 1-June 30, 1955-76*[1]

Year ending	Total	July-December	January-June
		Inches	
1976	8.98	5.69	3.29
1975	9.44	3.40	6.04
1974	6.98	4.11	2.87
1973	7.29	4.19	3.10
1972	7.91	4.16	3.75
1971	9.80	5.52	4.28
1970	10.27	3.54	6.73
1969	12.59	5.90	6.69
1968	6.79	2.63	4.16
1967	11.13	5.37	5.76
1966	6.57	4.36	2.21
1965	10.12	5.43	4.69
1964	11.19	4.12	7.07
1963	10.54	5.40	5.14
1962	9.39	4.38	5.01
1961	7.68	4.56	3.12
1960	10.96	4.39	6.57
1959	6.23	1.99	4.24
1958	10.74	2.75	7.99
1957	12.47	4.68	7.79
1956	10.01	4.90	5.11
1955	8.01	3.01	5.00
Mean	9.31	4.28	5.03

Source: U.S. Weather Bureau.

[1] To convert inches to millimeters multiply by 25.4.


SNAKE
RIVER
MALHEUR RES
Huntington
Birch
Brogan
LOYE RES
Mores
Lancaster
Aikin
S Fork
Jamieson
Ontario
Vale
20
201
Nyssa
RIVER
Dry
Cottonwood
Creek
Westfall
Bully
Cottonwood
AGENCY VALLEY RES
Beulah
Harper
Littlevalley
Jonesboro
MALHEUR
Juntura
MALHEUR
Drewsey
20
WARM SPRINGS RES
Squaw
Sand
Rock Canyon
Hog Creek
Owyhee
OWYHEE RESERVOIR
OWYHEE
Crowley
1
2
3
4
5
1 Deep alluvial soils sierozem calcisols
2 Sierozem desert alluvial association
3 Lithosols of primarily rhyolitic origin, brown chestnut
4 Lithosols of primarily granitic origin, chestnut
5 Lithosols of primarily basaltic origin, brown chestnut

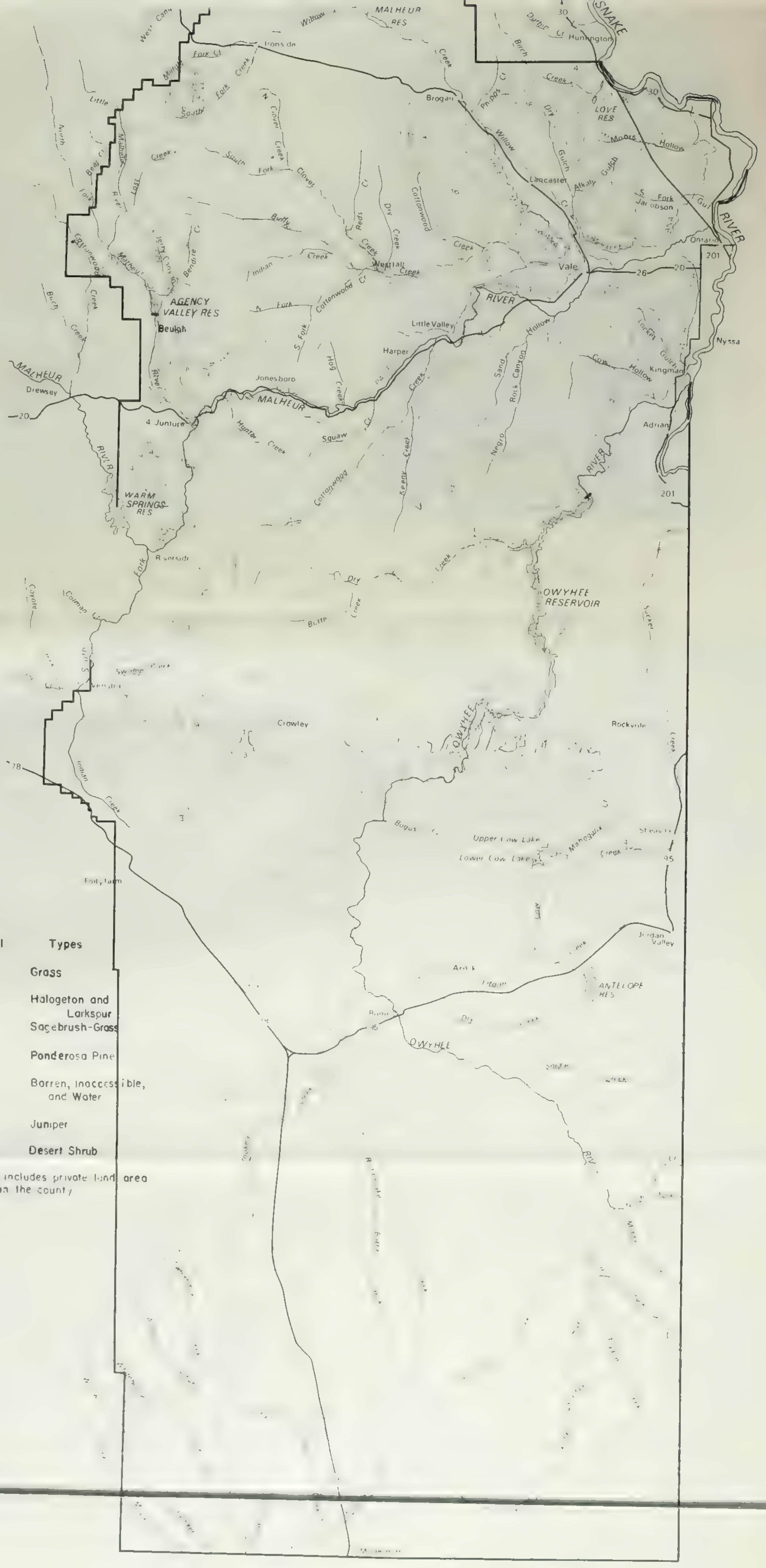


Figure 7.--Vegetation, 1961.

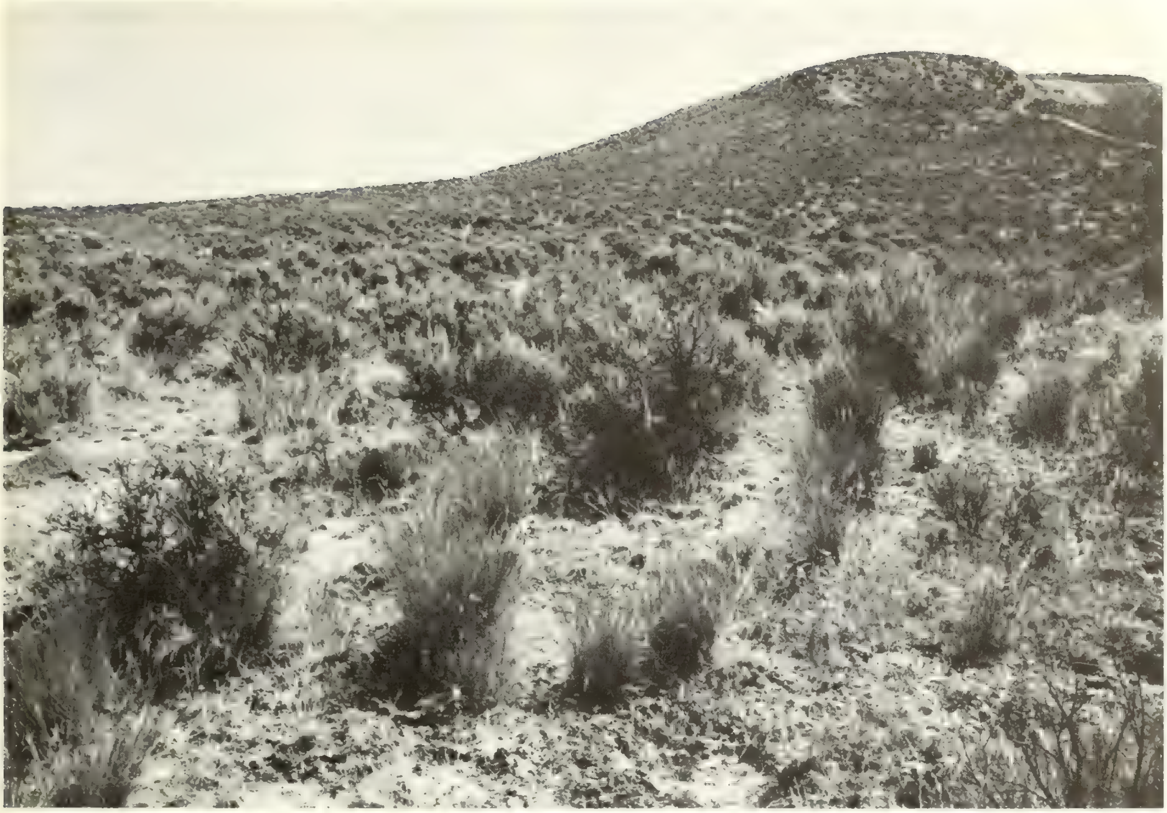


Figure 8--Big sagebrush with a mixture of perennial grasses characterizes a large part of the district.

Table 2--*Area of vegetational types on Federal lands administered by Bureau of Land Management, 1961-64.*

Types	1,000 acres	1,000 hectares
Grass	274	111
Halogeton and larkspur	7	3
Sagebrush-grass	4,068	1 648
Ponderosa pine	5	2
Barren, inaccessible, and waste	17	7
Juniper	53	21
Desert shrub	211	85
Total	4,635	1 877

At high elevations near the extreme northern edge of the Vale District, sagebrush-grass intergrades into the ponderosa pine (*Pinus ponderosa*) type typical of the Blue Mountains to the north. Few pine trees actually grow within the district. Western juniper (*Juniperus occidentalis*) occurs at high elevation throughout the Vale District. These areas are mapped as type 9 (fig. 7). The juniper type is essentially sagebrush-grass with the addition of scattered juniper trees. The shrubs and grasses are typical of adjacent areas without trees.

Lower elevational vegetation with rainfall of less than 10 inches (25 mm) and with alkaline soils of the sierozem desert type also intergrades with the sagebrush-grass type. Shadscale (*Atriplex confertifolia*), budsage, and spiny hopsage (*Grayia spinosa*) characterize the desert shrub, type 16 (fig. 7), in a mosaic with big sagebrush (fig. 9). Principal grasses are squirreltail and Sandberg bluegrass. This vegetation constitutes a desirable winter range on the district because of the many palatable browse species.

The vast area described as sagebrush-grass is characterized by complex, intergrading mixtures of several dominant plant species, depending on prior treatment and varying microsite. Climax vegetation of much of the region is a mosaic of sagebrush and native bunchgrasses. Forbs and the annual cheatgrass (*Bromus tectorum*) are ever present. Excellent range may contain up to 25 percent sagebrush. The mix of bunchgrasses and sagebrush at the start of the Vale Program had been strongly tipped toward high brush density and few palatable bunchgrasses as a result of a century of often exploitive grazing. In some locations, a perennial grass understory was almost absent with annuals or bare soil occurring between the shrubs. In 1961 only 1 percent of the Vale District was described as excellent, or near climax range. Ninety-nine percent reflected varying degrees of range deterioration as exemplified by a reduction in palatable perennials in the understory and an increase in brush density.

Shrub species characteristic of the sagebrush-grass type in addition to big sagebrush are low sagebrush, rabbitbrush, bitterbrush (*Purshia tridentata*) and mountain mahogany (*Cercocarpus ledifolius*) (fig. 10). Understory plants in good to excellent range are mainly bluebunch wheatgrass, giant wildrye (*Elymus cinereus*) on lowland sites, and Idaho fescue on north-facing slopes and at high elevations. Common perennials in the understory, especially where the range is in fair to poor condition, are the less desirable grasses, squirreltail and Sandberg bluegrass. Cheatgrass may be the only common understory plant, reflecting past extreme use which eliminated the perennials.

The grass type in figure 7 includes large burned areas where the sagebrush was missing and either cheatgrass, Sandberg bluegrass, or both dominated Halogeton (*Halogeton glomeratus*) and larkspur (*Delphinium* spp.) also indicate poor condition ranges and were located in small areas southwest of Rome and near McDermitt. They were much reduced in size since the map was drawn in 1963-64 because of their replacement through plant succession and range rehabilitation.

Streamside woody vegetation, too small in area to be mapped but highly important habitat for wildlife and control of erosion, includes willow (*Salix* spp.), cottonwood (*Populus trichocarpa*), hawthorn (*Crataegus* spp.), and wild cherry (*Prunus* spp.). In the alkaline areas, greasewood (*Sarcobatus vermiculatus*) dominates the riparian community.

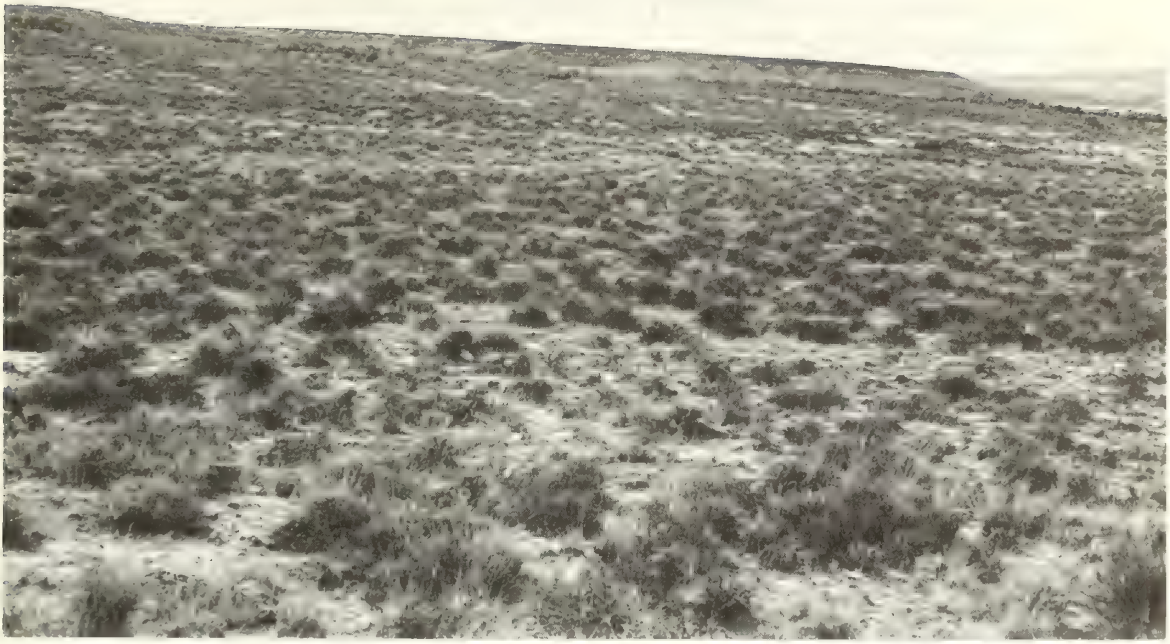


Figure 9--The low sagebrush type with scattered grasses grows on thin, rocky soils (Bureau of Land Management photo).

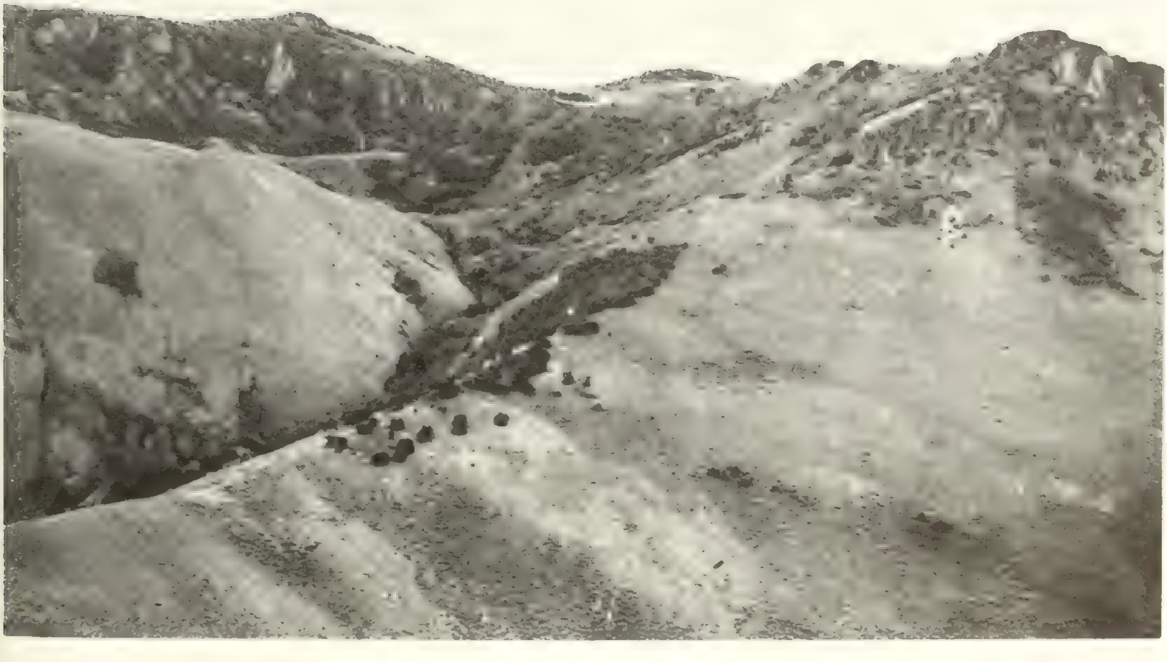


Figure 10--Bitterbrush and mountain mahogany often occupy the north-facing slopes and coves near the tops of mountains.

Demography and Economic Profile of Malheur County, Oregon

POPULATION

All but a few of Vale District permittees reside in Malheur County which is essentially the same area as the BLM District. Therefore, census data as presented here for Malheur County accurately describe the Vale District. The population of 23,380 in 1970 was highly concentrated in the irrigated crop region in the northeast. Fewer than 850 persons resided in the remainder of the county, giving that part an average density of one person per 6,000 acres (2 400 ha), and making it one of the most thinly populated areas of the United States. Total county population has remained relatively constant since 1950, showing a net increase of only 175 from 1950 to 1970. During that period, rural populations declined; the major city of Ontario grew from 4,465 in 1950, to 7,140 in 1972, and 7,710 in 1975. The number of people in the age group 20 to 40 years declined, and the number of persons older than 40 increased during 1950 to 1970. These trends in distribution and age structure approximate similar trends in the United States.

ECONOMY

The economic base of Malheur County is primarily agriculture and related industries with livestock raising, the largest single component, contributing about $15 million or 22 percent of the total annual county income. Nearly 100,000 acres (40 000 ha) of privately owned irrigated land depend on the Owyhee Reservoir for water. Additional lands are irrigated from waters in the Malheur River and Bully Creek. Other major economic inputs into the county are from hunting and other forms of recreation.

Malheur County livestock trends since 1920 typify those observed in many parts of the Intermountain West (table 3). Cattle numbers nearly tripled between 1920 and 1970 with a correspondingly dramatic decline in horse, mule, and sheep numbers. Overall forage consumption, as indicated by AUM's of livestock use in the county, was only slightly less in 1970 than in 1920. Peak forage consumption occurred in 1960 with a low in 1940 at barely half of the peak. Public lands contributed 22 to 37 percent of the total forage provided to county livestock. Approximately 64 percent of the ranchers have had grazing permits on public lands since 1934.

Ranches in the Vale District are typically small with an average herd size of 280 head in 1961 and 320 head in 1974. A trend toward consolidation into larger operations is shown by the frequency distribution in table 4. This increase in ranch size reflects a reduction in the number of ranches in Malheur

Table 3--*Numbers of livestock and forage provided by public lands in Malheur County*

Year	Cattle	Horses and mules	Sheep	County	Public land	Forage from public lands
				- - - AUM's[1/] - - -		Percent
1920	62,265	22,740	403,685	1,988,904	2/	2/
1930	37,149	13,608	342,264	1,430,518	2/	2/
1940	65,234	12,901	131,300	1,132,812	418,592	37
1950	114,672	7,327	50,874	1,586,086	463,935	29
1960	153,753	4,268	55,744	2,030,038	451,537	22
1970	152,352	3/	23,000	1,839,295	442,974	24

Source: Bureau of Land Management (1974).

[1/] Animal unit months.

[2/] Unknown before BLM District was established.

[3/] Combined with cattle numbers.

County from 719 in 1964 to 419 in 1970. Sheep ranches with permits on the public lands declined from 14 in 1961 to 1 in 1975. A shortage of skilled labor in handling sheep appears to be an important cause in their decline.

Employment in Malheur County totaled 9,418 in 1970 with services and trades contributing 47 and agriculture 21 percent of the total work force. Food processing employed 19 percent of the county's workers in 1970. Increased farm mechanization, with a resulting decrease in employment directly in agriculture, has been compensated by rapid expansion of food processing. In 1950, 48 percent of the county workers were employed in agriculture with only 2 percent in food processing. Services and trades, which increased from 36 to 47 percent of the work force between 1950 and 1970 will likely continue to expand as Ontario becomes increasingly the trade center for the region.

Median income per household in Malheur County was the lowest in Oregon at $5,903 in 1971. The average payroll per worker ranked second lowest in Oregon at $5,672. Unemployment in 1970 was 6 percent in the county compared with the eastern Oregon average of 7.1 percent.

In summary, the ranching population is small and most jobs stem from crop-related industries. Malheur County has lower levels of income and higher rates of unemployment than most urban communities in the Intermountain area. Significant outmigration, except from Ontario, foretells continuing problems such as scanty social services and cultural amenities. Diversification and industrialization have little chance because the primary production depends on land, which cannot be changed. The rangeland rehabilitation program and the continuing inflow of new monies to manage the rangeland resources have helped to stabilize the community. Reconstitution of the BLM District Advisory Board to include persons with a wide spectrum of interests should further stabilize land use and community *esprit de corps*.

Table 4--*Frequency distribution of grazing licenses and permits, Vale District, Bureau of Land Management, 1961 and 1974*

Animals	No. of permittees	Percent	No. of head	Percent
		1961 GRAZING YEAR		
Cattle and horses:				
1- 25	21	6.6	418	0.5
26- 50	23	7.2	938	1.1
51- 100	62	19.5	4,994	5.5
101- 200	81	25.5	12,591	14.1
201- 350	50	15.7	13,872	15.5
351- 500	27	8.5	11,374	12.7
501- 1,000	42	13.2	27,539	30.9
Over 1,000	12	3.8	17,547	19.7
Total	318	100.0	89,273	100.0
Sheep and goats:				
1- 100	--	--	--	--
101- 250	--	--	--	--
251- 500	2	14.3	900	2.2
501- 1,000	2	14.3	1,317	3.3
1,001- 2,500	8	57.1	15,050	37.6
2,501- 5,000	1	7.2	4,810	12.0
5,001-10,000	--	--	--	--
Over 10,000	1	7.1	18,000	44.9
Total	14	100.0	40,077	100.0
		1974 GRAZING YEAR		
Cattle and horses:				
1- 25	30	12.8	466	.6
26- 50	16	6.8	636	.8
51- 100	30	12.8	2,257	3.0
101- 200	45	19.2	7,209	9.5
201- 350	40	17.0	11,466	15.1
351- 500	25	10.6	10,705	14.1
501- 1,000	37	15.7	26,116	34.4
Over 1,000	12	5.1	17,038	22.5
Total	235	100.0	75,893	100.0
Sheep and goats:				
5,001-10,000	1	100.0	8,000	100.0

History of Land Use and Its Effects

PRIOR TO 1934

When Captain George Vancouver arrived on the Washington coast in 1792, he recorded the presence of cattle, sheep, goats, pigs, and poultry belonging to Spaniards. Cattle raising spread up the Columbia and Snake River systems to Fort Boise and Fort Hall in Idaho as early as 1834. The first of a flood of people traveling by covered wagons passed through Vale and the northern part of the district beginning about 1843. All these early travelers and settlers maintained livestock, on which they depended for food, power, and clothing. Hanley and Lucia (1974) and Oliphant (1968) gave particularly good historical accounts of land use, much of it directly applicable to the Vale District.

The rush for gold in California intensified the need for animals and resulted in the beginning of an animal industry throughout the Western States. Between 1850 and 1865, every creekbed and likley geological formation was searched for gold and silver. In 1863, Michael Jordan discovered gold in Jordan Creek and others opened mines at Silver City in the Owyhee Mountains not far away to the east. People came to the area by the thousands, including miners, Chinese laborers, freighters, stagecoach operators, roadbuilders, saloon keepers, bawdy house madams, ranchers, and roustabouts. Many used the route from McDermitt to the Rome crossing of the Owyhee River and through the Jordan Valley. All needed horses for travel and beef to eat.

Occasional raids by Indian parties until 1878 restricted travel except along the roads but hardly reduced the use of extensive rangeland areas by livestock. The district, as well as adjoining regions, received many herds from 1865 onward and rapidly became fully stocked with cattle owned by a few ranchers who controlled large land areas. Between 1876 and 1882, as many as 150,000 cattle per year trailed eastward from Oregon and Washington to Denver and the northern Great Plains. It was also a time of great losses from poisonous plants, blackleg and other diseases, and dependence on the chinook winds to melt the snow so cattle could graze in the winter. The long and severe winter of 1889-90 reduced many cattle herds to near zero thus ending an era of control by the western cattle barons. Sheep were completely eliminated. In the following years, many herds and bands were brought from southern ranges to fully stock the Owyhee ranges again.

Sheep raising and farming began in the Owyhee country about 1865. Many sheep were in migrant bands which traveled over "free" range, as the land claims of the cattlemen were ignored. Homesteaders gradually fenced the water, further complicating the use of the rangeland. Although resident cattlemen, sheepmen, and farmers often remained helpful to each other, the migrants of all three types caused great conflicts. They took all the grass and water, plowed some land, and moved to greener pastures. The catastrophic winter of 1889-90 altered the balance of use toward more sheep on the rangelands. For example, the largely Basque community in the valley of Jordan Creek controlled an estimated 200,000 sheep in the 1920's and early 1930's. Cattle now dominate again; in 1975 only 7,400 sheep were permitted to graze in the whole of the Vale District.

Horses arrived in eastern Oregon about 1750, and most people who came also owned horses (Jackman and Long 1964). The well-known trappers, Donald MacKenzie in 1818 and Peter Skene Ogden in 1824-29, searched for beaver in the Owyhee, Malheur, and Snake River drainages. Each party had 30-50 men and well over 200 horses (Cline 1974). Indians stole some of the horses. Few became feral until after the last Indian war in 1878 when horse numbers increased rapidly. Thousands roamed the ranges of the Owyhee country from 1900 to the mid-1940's. During that time, gathering mustangs (from the Spanish mestengo meaning wild horse) provided income for ranchers in the area. Herds were reduced to low numbers following World War II.

No doubt exists that cattle, sheep, and horses occupied the grazing lands of the Vale District in large numbers for about 60 years beginning in 1875. Little hay or other winter feed was available so the use was yearlong. Grazing on farm-raised feeds and haying increased after the winter of 1889-90. Probably, range deterioration had reached severe proportions by 1900. Lack of livestock controls on the public domain until 1934 permitted continued rangeland deterioration and erosion.

Between 1863 and 1866, 3 alternate square miles of land were granted for building each mile of the Oregon Central Military Road from Silver City through Jordan Valley to Fort Smith and westward through central Oregon (Preston 1970). These land grants preceded similar ones for building railroads across the West some 5 or more years later. Although the road was not well constructed, the land was appropriated and shows today as a checkered landownership pattern (fig. 2).

In response to popular demand, Congress passed the Homestead Act in 1862 providing title to 160 acres (64.8 ha), if the person lived on the land and used it over a 5-year period. This act and later versions, the Desert Land Act in 1877, Enlarged Homestead Act in 1909, and the Grazing Homestead Act in 1916, influenced landownership in the district. The State of Oregon received sections 16 and 36 to support schools, an Indian reservation was established near McDermitt, and lands have been withdrawn for public reserves of various kinds. Table 5 shows the result of these factors in terms of landownership. Differences between 1961 and 1976 reflect changes in the boundaries of the Vale District and changes in ownership. Land trades and sales are gradually consolidating the crazy-quilt ownership pattern which developed before 1934. The Vale District has been approximately 75 percent Federal land since it was formed.

Table 5--*Landownership in the Vale District, Bureau of Land Management, 1961 and 1976*

Land administered by	1961		1976	
	Acres[1]	Percent	Acres[1]	Percent
Bureau of Land Management:				
Public lands	4,578,311	70.01	4,604,878	71.12
BLM reserved lands	6,833	.01	58,438	.90
Other Federal	53,674	.83	21,778	.34
Non-Federal	304,900	4.66	298,920	4.62
Total	4,943,718	75.60	4,984,014	76.98
Other:				
Federal lands	128,465	1.97	27,560	.42
Private and State	1,466,633	22.43	1,463,191	22.60
Total	1,595,098	24.40	1,490,751	23.02
Total	6,538,816	100.00	6,474,765	100.00

Source: Bureau of Land Management.

[1] 1 acre equals 0.405 hectare.

1934 to 1962

Until 1934, the public domain was free to be claimed by the user whether the purpose was to graze it or to "prove a claim" and actually be granted a deed or patent. The land belonged to all and yet no one was responsible for sound land use. A 1642 Virginia law, upheld for the Northwest Territory in 1792, stated: "The open woods and uninclosed grounds within the Territory shall be taken and considered as the common pasturage or herbage of the citizens thereof saving to all persons their right to fencing" (Oliphant 1968). This law was interpreted to mean free range and a lawful fence. Such practices as yearlong grazing, branding, and the cooperative roundup developed as a result. Free range and the right of transit between States without taxes favored nomadic herds of livestock, mainly sheep. These customs received sanction in an 1890 U.S. Supreme Court decision which stated that English common law did not prevail because it was ill-adapted to the nature and conditions of the country. The English law stated "that every man must restrain his stock within his own grounds, and if he does not do so, and they get upon the unenclosed grounds of his neighbor, it is trespass for which their owner is responsible."

Many conservationists, ranchers, farmers, politicians, and members of the general public recognized that rangelands were deteriorating but accepted this in order to develop the West. Livestock overgrazed, miners prospected everywhere, and homesteaders made their own choices of land to plow. They not only did these things but also were encouraged to do so by the laws of the land, court decisions, and the overall public attitude. Some activities of cattle kings, migrant sheepmen, and homesteaders were regrettable in hindsight but destructive land use was the level that was maintained at the time. In effect, political decisions directed social forces to destroy the range vegetation and to retard its recovery because of "crazy-quilt" landownership patterns. It would seem that the public as well as private interests contributed to rangeland deterioration; the Vale District was just a small example from the whole West. It would also seem appropriate as the price for opening the West for the public to shoulder a part and perhaps all of the rehabilitation of deteriorated public rangelands. The costs to repair the land and the costs of maintenance should be public costs, otherwise the bearer of the cost develops a vested interest.

With passage of the Taylor Grazing Act in 1934, a major step was taken to rectify the land use problem on the public domain. The purpose of the act was "to preserve the land and its resources from destruction or unnecessary injury, to provide for the orderly use, improvements, and development of the range." This act followed the various homestead acts, and technically marked the end of that era. Cattlemen, sheepmen, and farmers had been fighting over land for 50 years. Submission to the new law was difficult. Regulations, such as issuance of permits, determinations of grazing capacities, setting of allotment boundaries, improvements to be constructed, formulas to set grazing fees, and other administrative ground rules came in to play gradually.

Allocation of grazing privileges quickly became the principal issue. Final preference was to be given to those with commensurate property but the demand outstripped the supply of AUM's of grazing. Therefore, in practice, first priority grazing privileges went to those with commensurate property and prior use during a 5-year period before passage of the law.

The new Grazing Service depended on advisory boards elected by the permittees to set grazing capacities and priorities of use. Persons most influential in the community became board members, thus assuming positions of power. Migrant sheepmen were out; the permittee's grazing rights were not always proportionally reduced when cuts had to be made; correct data on base properties were not marshalled; Federal expenditures were supervised; and advisory boards selected and determined tenure of Federal employees. These were a few of the powers rightly or wrongly exercised by some of the advisory boards. The one in the Vale District was notable for its independence and power. Its principal purposes were to maintain the status quo of range use and lowest possible grazing fees.

An example of the dispute was described by Foss (1960) as the "Battle of Soldier Creek." Soldier Creek is a grazing unit near Jordan Valley in the central part of the district. In 1935 the commensurate base for the unit was set at 77,419 AUM's, but the advisory board set grazing capacity at 43,260 AUM's. A range survey in 1951 set the grazing capacity at 31,284 AUM's; but the permittees continued to demand 77,419 AUM's, although many fewer AUM's were being used. In 1956 a careful study that marshalled data on base property indicated an eligibility for 31,000 AUM's. After numerous meetings that number was accepted and the dispute was over. Many more details may be found in the publication by Foss (1960).

The ranchers in the Soldier Creek unit were anxious to maintain their ranges and to stay in business. They built fences, developed additional water and, in a few instances, controlled sagebrush. Migrant sheep were eliminated in 1934 and 1935. Throughout the period, the ranchers were improving their stewardship of the land as well as attempting to protect their positions in arguments with the Federal agencies over permitted livestock numbers. It is incorrect to describe either side as totally right or wrong in the "Battle of Soldier Creek."

VEGETATION BEFORE GRAZING BY DOMESTIC ANIMALS

Although a few head of horses may have grazed in the district as early as 1818 when Donald McKenzie sent trappers to follow the Owyhee River, heavy stocking probably began with the discovery of gold in 1863. Evidence from many sources, most of it circumstantial, contributed to the development of our visualization of the pristine climax vegetation in 1863.

Oliphant (1968) cites writings of Harvey H. Hines, a Methodist minister, who stated, in 1882, that the lower Malheur River plains were covered with sage, but that was nearly 40 years after people crossed from Snake River to Vale as a part of the Oregon Trail. The surveyor-general of Idaho reported some lands in Oregon and Nevada as grazed-out in 1871. Vale (1975) reviewed 29 journals and diaries of early travelers who mainly followed river routes in the sagebrush-grass region--none of the 29 traveled extensively in the Vale District. They reported abundance of sagebrush on lower slopes and terraces and large amounts of grass at upper elevations. Hines also described the higher country south of Vale, Oregon, in 1882 as mostly covered with bunchgrass.

In addition to grazing influences, range fires were set by Indians both before and after white men arrived (Oliphant 1968). Lightning caused fire then as it does today. Introduced plants, such as Russian thistle (*Salsola kali*), Halogeton, and cheatgrass had not arrived. In the last 20 years, plant succession has moved rapidly toward climax as a result of managed grazing, according to the data now available. Exclosures, one as old as 40 years, have been studied. Plots of various ages also gave us information on successional trends. We pieced together this information as our best guess of the original climax vegetation in the Vale District. Excellent publications by Daubenmire (1970) and Franklin and Dyrness (1969, 1973) include discussions of stable vegetation as it was before the advent of Caucasian man. We found that those publications contained accurate descriptions of the vegetation in the district.

There are two major types of pristine vegetation in the Vale District. One type was dominated by big sagebrush and bluebunch wheatgrass (fig. 11). Shrub cover remained less than 25 percent and may have been near zero following fires. We have no evidence that big sagebrush can be eliminated from this

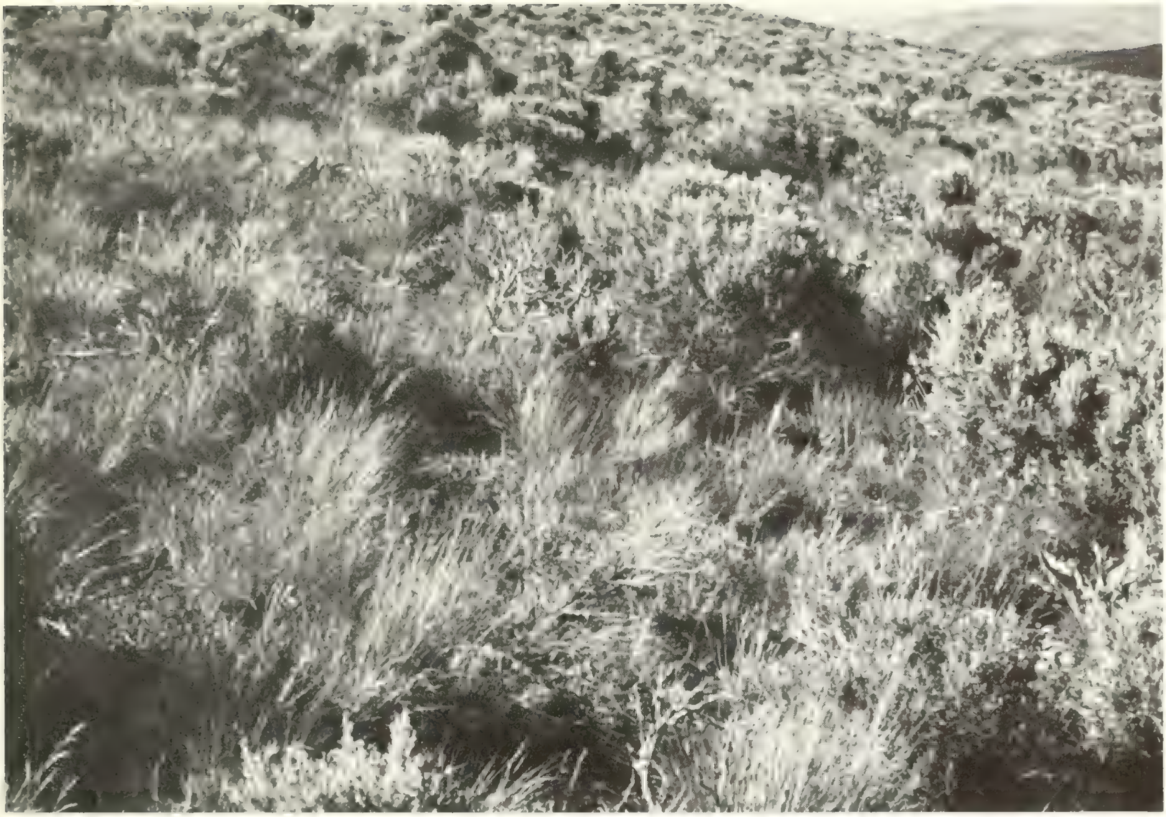


Figure 11.--Bluebunch wheatgrass and big sagebrush.

vegetation nor that it covered as much area as grass did. Other species characterized the type according to elevation, soil, and rainfall. Sandberg bluegrass and squirreltail were in dry areas; low sage replaced big sage on shallow stony soils; Idaho fescue and bitterbrush reached codominance with bluebunch wheatgrass and big sagebrush at upper elevations. This combination composed the understory in juniper and ponderosa pine. Other minor species included Thurber needlegrass (*Stipa thurberiana*), prairie junegrass (*Koeleria cristata*), needle-and-thread (*Stipa comata*), and several shrubs. This grassland with shrubs scattered or in moderately thick stands, but always variable, extended over at least 90 percent of the district. At any one time, the landscape probably showed a mosaic of sagebrush densities, with low density following fire and a gradual increase until the next fire occurred.

The second major vegetation type grew on alkaline soils and was composed primarily of shrubs. Shadscale dominated; and others included spiny hopsage (*Eurotia lanata*), budsage, and greasewood. Bluebunch wheatgrass occurred in the type but larger amounts of squirreltail and Indian ricegrass (*Oryzopsis hymenoides*) characterized the landscape. The grass dominated if the soil was sandy. This type occupied about 6 percent of the district.

We offer several other descriptive points about the pristine vegetation. Grasses occurred between widely spaced shrubs as well as under their canopies. Without grazing or fire, large amounts of litter accumulated in the centers of some of the bunchgrasses. Grazed or burned bluebunch wheatgrass plants often appeared more vigorous than those left untouched for years. The pristine vegetation, of course, did not contain several introduced species, which are present in today's climax vegetation. Riparian communities, wet meadows, lakebeds, and rocky and barren areas occupied small acreages in the district. The native grasses did not burn as readily as cheatgrass.

DESTRUCTION OF COVER

Reconstruction of the pattern of range deterioration as shown by vegetation can only be done in general terms. Exploitive grazing after 1878, and perhaps locally before that date, probably reduced the perennial bunchgrasses from the interspaces among the shrubs. Annuals may have invaded the bare ground; but one must keep in mind that Russian thistle, cheatgrass, and other introduced plants had not arrived. Therefore, the invading species probably were the unpalatables such as poinsonous species and shrubs, including big sagebrush and rabbitbrush. Many more animals were lost to poisonous plants before 1934 than afterwards. Also, the sagebrush thickened, in some examples becoming monocultures with few other plants (fig. 12). A temporary halt, or a couple of years of rest and recovery, occurred following the livestock die-off in the winter of 1889-90. The lowest point in the vegetational destruction and bare soil probably occurred between 1900 and 1920. Griffiths (1902), following his observations between Winnemucca, Nevada, and Ontario, Oregon, in 1901, reported finding large areas of bare soil and traveling 1-3 days across deteriorated ranges. Sandberg bluegrass, which matures in early spring, probably remained in the openings; but the dominant grasses were found only in the protection of shrubs and rocks. They may have disappeared altogether from sizable acreages, especially those burned. Russian thistle arrived about 1900 and was followed by mustards (*Brassica* spp., *Sisymbrium* spp.). Invasion by cheatgrass about 1915 and its spread over large areas of rangeland during the 1920's (Stewart and Hull 1949, USDA Forest Service 1914) increased ground cover and provided a flash fuel and scanty forage, but more than had been produced for a few years. Fires which were common in the 1860's to 1880's again became common. Stands of pure sagebrush burn only with high winds.

It seems to us that plant succession toward increased cover, less erosion, and at least some grass forage production was underway by 1934 and continued thereafter. Stages of succession as suggested by Piemeisel (1938, 1951) for big sagebrush-grass in the Burley BLM District in Idaho apply here. The climax appears to be similar, and the same species are present. Russian thistle is the first on bare soil. Next come the mustards and other annual forbs; cheatgrass soon follows (fig. 13). Cheatgrass and Sandberg bluegrass may last for years as pure stand where burning removes the sagebrush, or the combination may be closely associated with brush stands (fig. 14).

PATTERN OF RANGE DETERIORATION

In the Vale District, as elsewhere, ranges suffer most near water and centers of human population. The first area overgrazed occurred along the Oregon Trail, which crossed the northeast corner of the district from the mouth of the Boise River into Snake River to Vale and north to Farewell Bend of the Snake River. The trail was broad, and livestock were moved outward to find feed. Even today that belt has some of the poorest condition ranges in the district. Other points of population concentrations and high livestock pressures

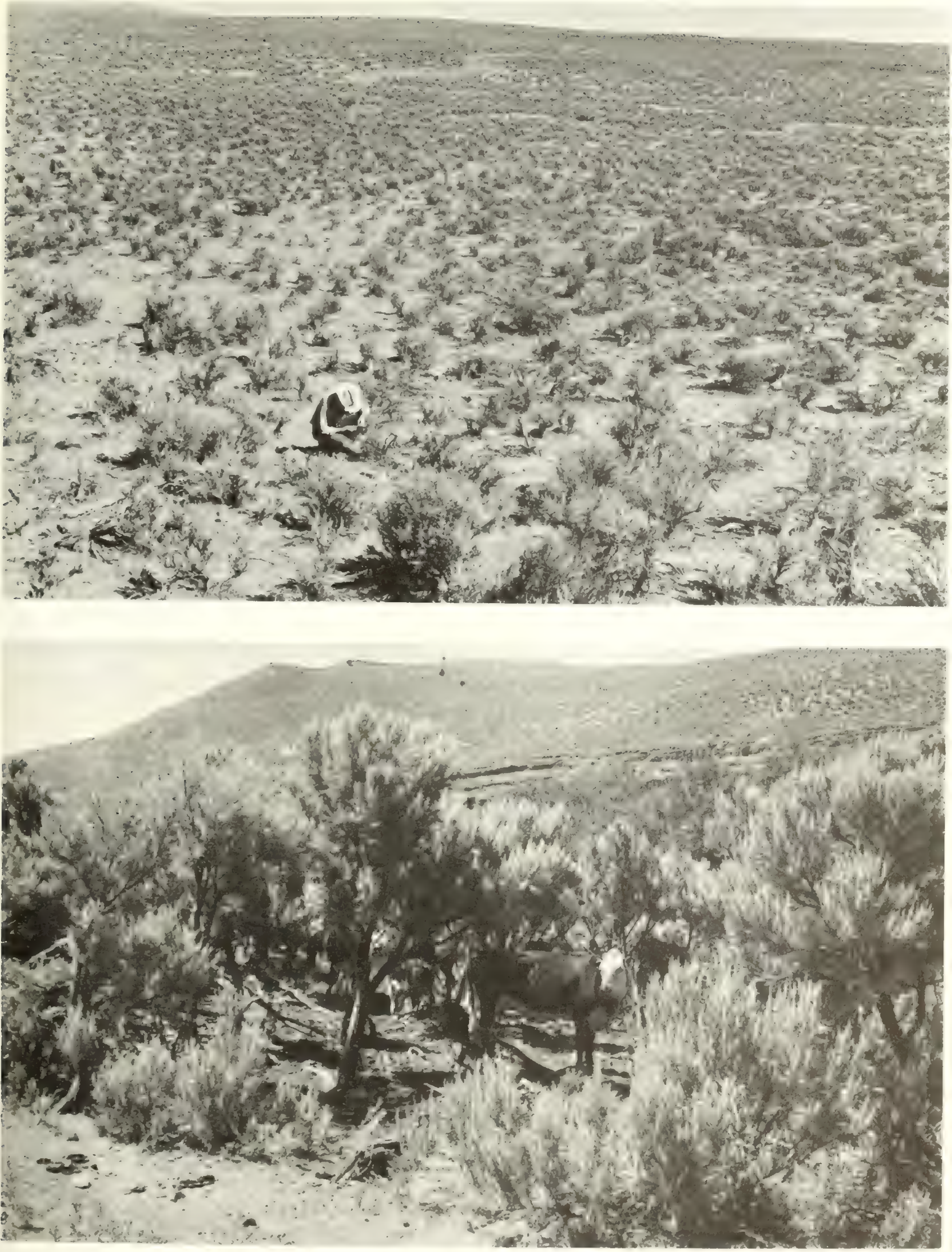


Figure 12.--Severe grazing resulted in monocultures of big sagebrush on these sites (Bureau of Land Management photos).

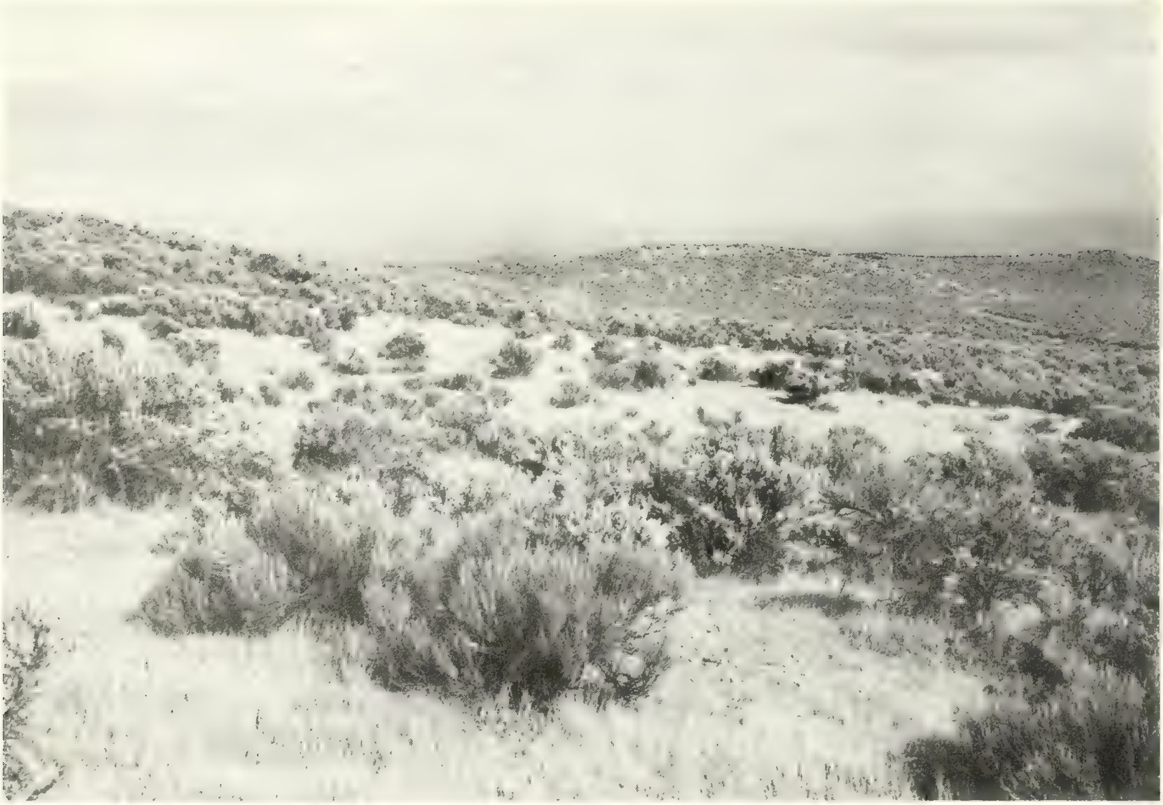


Figure 13.--Big sagebrush and rabbitbrush with a complete stand of cheatgrass.

include those around Westfall, Harper, Rome, and to a lesser extent near Jordan Valley and McDermitt. The areas where damage occurred latest and perhaps not to a serious extent because of lack of water are exemplified by bits of country near Skull Springs south of Harper and Antelope Creek northeast of McDermitt.

Until permanent stock water was developed after 1934, the remote areas were grazed in the spring and the livestock removed to the creeks, rivers, and other permanent waters as temporary water failed. Nomadic bands of sheep moved through the district, repeatedly grazing in the spring as one band followed another. In short, the uncontrolled grazing led to centers of destruction concentrated around the villages. These destroyed areas were located at the lowest elevations where temperatures were hottest, rainfall least, and the dry season longest. They remain the areas of rangeland in the district needing the greatest repair and at the same time they are the hardest to fix. Unfortunately, the destroyed areas are the first and most often seen by the population, resulting in a widely held belief that the Vale Rehabilitation Program has largely failed. As will be shown later in this report, the opposite is true.

WILD ANIMALS 1776-1962

During October 1776, Father Escalante, a Franciscan friar, led a party westward across northern Utah to Utah Lake and southward to Arizona. He made

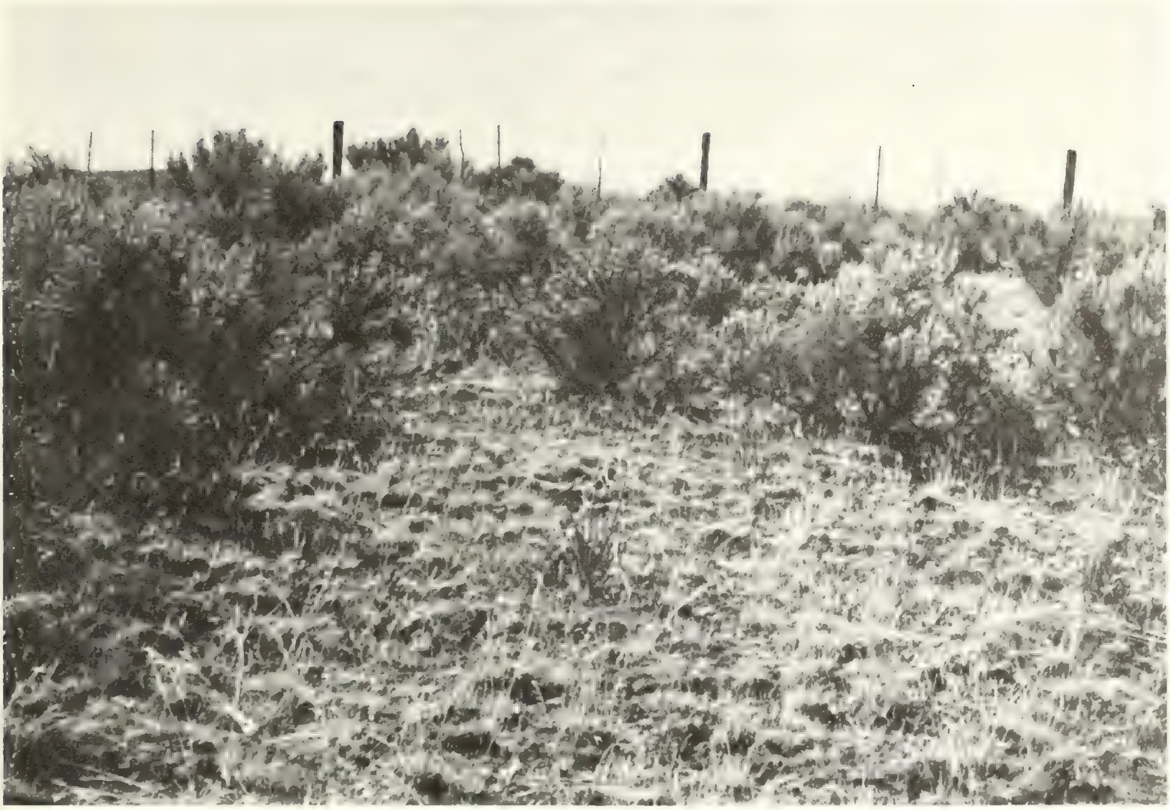


Figure 14.--Big sagebrush and Sandberg bluegrass precedes the climax.

no mention of deer and elk, seen earlier in Colorado, and experienced difficulty in finding food (Utah State Fish and Game Commission 1948). In 1826, Peter Skene Ogden found deer in abundance along the Snake River near the mouth of the Malheur River; but they were scarce across Oregon to the west, occurring locally. Also, he reported antelope in places (Davies et al. 1961). Apparently, buffalo, antelope, elk, and deer were present near Salt Lake, in southeastern Idaho (Williams et al. 1971), and in eastern Oregon. In March 1826, Ogden's men found elk near the present site of Twin Falls in southern Idaho; but 3 months later the party was eating horsemeat during their travels along the headwaters of the Bruneau and Owyhee Rivers (Cline 1974). Clearly, the populations of elk, deer, antelope, and buffalo were small in the northern intermountain region when the fur trappers crisscrossed the Owyhee region from 1818 to 1830. Beaver, the objective of the expeditions, varied in density from stream to stream.

Wild animal species reach their highest populations in relation to abundance of food and water, which supplies individual needs, and to sufficient cover and space, where the species finds its needs for reproduction and running room (Thomas et al 1976). Preceding sections described probable vegetational characteristics in 1863 and the likely changes which followed. This section characterizes the changing food and cover for wildlife just as it does for livestock. For example, nearly all accounts of mule deer described them as scarce in the early climax vegetation and abundant in the shrub stage of succession from the 1920's to the mid-1960's. Poor or fair cattle range would provide excellent browse for deer. Sagegrouse also do well in sagebrush but antelope reach peak numbers in grasslands. Each species has its own best habitat, but these may be difficult to define.

The migrating species use selected sites and vary in density seasonally as well as by location. The trapping expeditions may have missed the migrations, but as with livestock, the centers of concentration should have been near water. Beaver were not plentiful on all streams. It seems fair to suggest that man's use of the range has affected the different species to various degrees. The habitat may have improved for some species and deteriorated for others. Causes for changes in numbers of wild animals are not clear.

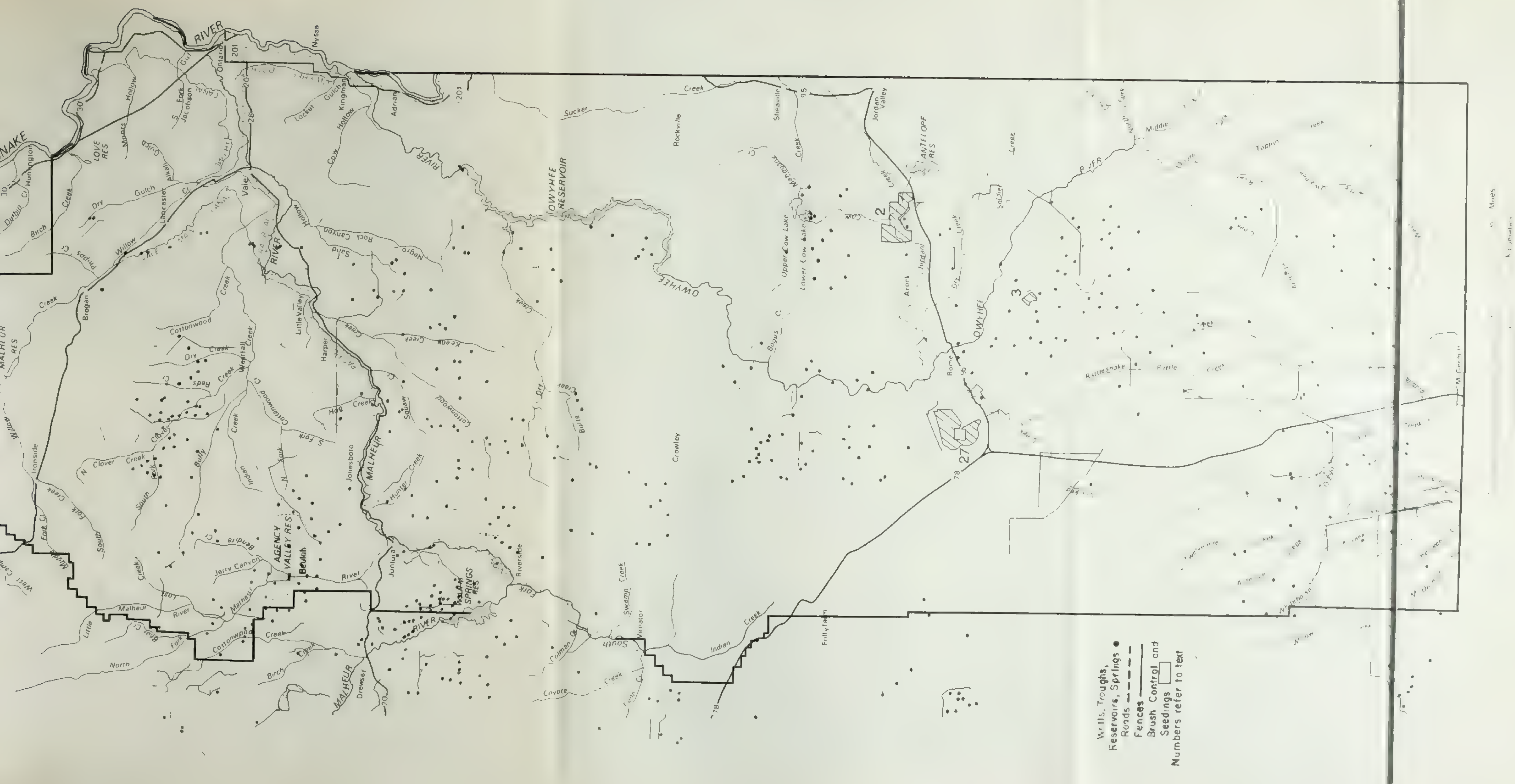
Several points need to be kept in mind when wildlife is considered in references to rangeland changes brought about by livestock and rehabilitation practices. Grassland may be the best for some species, sagebrush-grass for others, and sagebrush with bare ground between plants for others. The rangeland manager must know these ideal habitats for individual wild species, know how to attain them, evaluate which species the public wants, and judge the situation long enough in advance to finish the work project. None of these four requirements can be determined sufficiently for any wildlife species on the Vale District, although the rehabilitation program has considered them. The situations for a few of the 294 animal species in the district will be given in a later section as an evaluation of the rehabilitation programs. Data on individual species numbers before 1962 are too nebulous to warrant further discussions (Bureau of Land Management [n.d.].

RANGE REHABILITATION PRIOR TO 1962

No more than 0.1 percent of the rangeland in the Vale District had received a range improvement treatment prior to 1962. This included about 30,000 acres (12 000 ha) of brush control by spraying, plowing and seeding, and seeding after wildfires. Approximately 582 livestock watering points had received attention by ranchers and BLM personnel. Several drift fences had been constructed, but pastures had not been enclosed nor seasonal grazing plans established. The scatter of the projects prior to 1962 is shown in figure 15; but at the map scale used, only groups of water developments could be shown.

The negative side or lack of management prior to 1962 needs to be mentioned in order to emphasize conditions at the beginning of the Vale Program in the fall of 1962. No grazing systems were in effect beyond stipulation of allotment boundaries and dates of grazing. Permitted numbers of livestock and AUM's of grazing may or may not have been the same as actual use because BLM personnel were too few to make effective checks on trespass livestock. Erosion control with gully plugs, firebreaks, and construction of recreational sites had not been done. Resource surveys had covered approximately 30 percent of the public land, and adjudications to determine commensurate property qualifications had been completed for less than half the permittees.

Contributions to rangeland management by the permittees was perhaps in the same order of magnitude as by the BLM. Ranchers, either cooperatively with BLM or at their own expense, constructed almost 500 miles (800 km) of fence and developed numerous watering facilities. Ranchers did the fence repairs and



Wells, Troughs, Reservoirs, Springs ●
Roads
Fences
Brush Control and Seedings ▨
Numbers refer to text

Figure 15.--Range improvements before 1961.

maintenance. The start toward range rehabilitation before 1962 came as a cooperative effort between the BLM and the permittees--contrary to many stories in the public press which condemned the ranchers for being interested only in range destruction.

Range research at the Squaw Butte Experiment Station near Burns, Oregon, and in the sagebrush-grass type added still another factor that made the Vale Program feasible. The station superintendent emphasized in talks to ranchers and BLM personnel that a twofold increase in AUM's could be attained. Six management practices were needed: (1) more water to improve animal distribution, (2) more riding to scatter the cows, (3) sagebrush control by spraying, (4) seeding of crested wheatgrass (*Agropyron cristatum* and *A. desertorum*), (5) adjustments in opening and closing dates of grazing, and (6) providing sufficient winter feed. These practices had increased annual meat production per cow on the Squaw Butte Station from 150 pounds (70 kg) in 1946 to approximately 400 pounds (180 kg) in 1960 (Bureau of Land Management [n.d.]).

Thus, the district was ready in 1961 for a range rehabilitation program: (1) Range condition was poor and, if not deteriorating, certainly not improving; (2) open controversies indicated that a new program was needed; (3) a start at cooperation had been made; (4) information on what to do and how to do it was available; (5) local people, politicians, and the BLM were anxious to accomplish a land management program in place of wasting resources on disagreements over adjudication of grazing permits. The need for funds forced all parties to turn to Congress for help.

The Vale Rehabilitation Program

THE ORIGINAL PROPOSAL

The original proposal was prepared as a 28-page document by personnel of the Vale District of the Bureau of Land Management. It gave concrete suggestions for halting range deterioration in southeastern Oregon. A paragraph quoted from a letter written by three members of the Oregon State BLM Advisory Board on February 1962, indicates the praise and enthusiasm by people in Oregon for the proposal:

> The Bureau has had inadequate funds to improve the range and has, therefore, been forced to evaluate carrying capacities with little hope of improvement. This plan provides for positive improvement and continuous evaluation while improvement is underway. It also provides for adjudication on the basis of actual use supported by observations of range condition and trend. These things can be accomplished with adequate money and personnel.

Contingent upon funding by Congress, the project proposal specifically offered ". . . a solution to the national problem of depleted and deteriorating public rangelands. It proposes to do so without seriously impairing the livestock industry and supporting local economies. The Vale District would be a practical demonstration of the government's ability, through the BLM and the Department of the Interior, to solve a critical national problem." The objectives were ". . . a seven-year development program with emphasis on rehabilitation measures designed to protect and improve the soil, conserve and utilize the water, and increase forage for livestock and wildlife. It also considers the needs for recreational development and construction of service roads and related measures that will strengthen and improve the local economy" (Bureau of Land Management [n.d.]).

The Vale proposal specifically listed eight objectives:

1. To correct erosion and accompanying downstream sedimentation--and prevent further soil losses.

2. To increase the forage supply for wildlife and livestock.

3. To stabilize the livestock industry at the present or an increased level of production.

4. To facilitate fire control by replacing high hazard cheatgrass and sagebrush with low hazard perennial grasses and improving detection and suppression facilities.

5. To prevent the encroachment and spread of noxious and poisonous weeds.

6. To accomplish necessary land tenure adjustments.

7. To safeguard public lands from improper recreational use.

8. To provide for the development of access roads and service roads in the vast areas of untapped recreation potential.

The procedures to carry out these eight objectives were not specifically stated, although particular methods such as brush eradication, range seeding, and water development plans were mentioned in the proposal. The proposal encouraged the development of a particular plan or project for each specific area to satisfy the objectives. The program needed to be flexible as lessons were certain to become apparent from mistakes during the first few years. In fact, the Vale Program could be a model for other land treatment programs in addition to the direct results of the program itself.

Contrary to earlier range improvement programs, this one emphasized wildlife, recreational facilities, and watershed values. People expert in these subject areas contributed to the proposal and to the individual projects from the beginning.

PASSAGE THROUGH CONGRESS

Easy passage of the Vale Program proposal through Congress resulted from the emergence of several coincidental factors. First, the early 1960's marked the end of the bulk of legal action by Federal range users to delay implementation of cuts in permits as a result of adjudication. Second, this period marked a re-emphasis on conservation by the Federal government. Third, Senator Wayne Morse of Oregon, a long-time critic of BLM policy, was a candidate for re-election in 1962. With Congressman Al Ullman, Morse became an ardent supporter of the Vale proposal. These two men guided the passage of the special appropriations bill funding the Vale Program. Local support for the proposal and little opposition gave both Morse and Ullman direction to help southeastern Oregon, an area that had been troublesome to them for several years.

Certain specific recommendations, such as seeding to crested wheatgrass and the priority of various land treatment activities raised questions. A proposal on such a large scale caused many to wonder at its feasibility, but the obvious and real local benefits of such a program were never in doubt. The unwavering support of congressional sponsors, strong local encouragement, and a clearly written and well-planned proposal for implementation made possible the passage and funding of the program as a special appropriation in the Federal budget in the summer of 1962. Some money was spent before allocation of the funds occurred in September 1962. The first large-scale projects in the Vale Program began in the Cow Creek unit in summer of 1962.

BUDGET

The original proposal for the Vale Program estimated the total cost at $16,230,460 for 7 years. Cost for the first 2 years was to be $2,505,000, but Congress appropriated $2,071,789. From the beginning, the concepts, scheduling, and funding frequently changed from the original proposal. For example, an extensive 2-year range survey to identify suitable sites for treatment was immediately modified at the requests of Ullman and Morse. They wanted more money and more efforts put immediately into land treatment than the BLM had planned. Further, congressional backing apparently was in jeopardy without immediate on-the-ground results from rehabilitation efforts. Thus the range survey extended for 3 years, and several treatments were undertaken prior to thorough site evaluations. The program extended over an 11-year period and used total funds of about $10 million.

LAND TREATMENT PROJECTS

Land treatments were accelerated early in the program, and later slowed considerably due to receipt of less funds than requested. One hundred and sixty-four land treatment projects were finished (fig. 16). Table 6 lists them by name, year, acreage, treatment, and the location number in figure 16, providing an easy reference for location of results mentioned throughout this report. At the end of the formal Vale Program in 1973, some aspects of the program goals were exceeded; others were not met (table 7).

Table 6--*Land treatment projects in the Vale District, Bureau of Land Management, 1952-73*

Year	Number[1]	Name	Acres[2]	Treatment
1952	1	Ten Mile seeding	2,700	Plow/seed
1955	2	Soldier Creek seeding	2,015	Plow/seed
1960	3	Mud Flat seeding	400	Plow/seed
	4	Beulah seeding	1,150	Fire/seed
1961	5	McCain Springs seeding	2,675	Fire/seed
	6	Jordan Valley seeding	1,575	Fire/seed
	7	Downey Canyon seeding	1,429	Fire/plow/seed
	8	Brickey Springs seeding	2,744	Plow/seed
	9	Gluch seeding	3,567	Spray/seed
	10	Whitehorse brush control	10,400	Spray
1962	11	Mormon Basin seeding	919	Fire/seed
	12	Tableland brush control	2,500	Spray
	13	Hooker Creek seeding	2,292	Fire/plow/seed
	14	Jordan Valley brush control	1,098	Spray
	15	Rock Creek seeding	1,800	Plow/seed
	16	Monument brush control	1,800	Spray
	17	Monument seeding	1,800	Fire/seed
1963	18	Mormon Basin brush control	360	Spray
	19	Horse Flat brush control	2,773	Spray
	20	Poverty Flat brush control	1,050	Spray
	21	Mesa brush control	4,047	Spray
	22	Drip Springs brush control	4,003	Spray
	23	Tunnel Canyon brush control	5,920	Spray
	24	Bas brush control	3,800	Spray
	25	Owyhee Butte seeding	9,265	Plow
	26	Schnable Creek seeding	2,015	Fire/plow/seed
	27	Rome seedings	7,785	Plow/seed
	28	Sheep Springs seeding	685	Plow/seed
	29	Starvation brush control	20,098	Spray
	30	Indian Canyon brush control	2,650	Spray
1964	31	Love seeding	375	Plow/seed
	32	Vines Hill seeding	1,800	Fire/seed
	33	Chicken Creek seeding	4,464	Plow/seed
	34	Page seeding	4,400	Fire/seed
	35	Warm Springs brush control	7,713	Spray
	36	Winter Springs seeding	2,222	Plow/seed
	37	Sand Hollow seeding	3,300	Plow/seed
	38	Granite Creek brush control	3,550	Spray
	39	Top brush control	9,560	Spray
	40	Rockville seeding	3,600	Plow/seed
	41	Lodge brush control	6,500	Spray
	42	Old Maid seeding	1,900	Plow/seed
	43	Sticky Joe seeding	700	Plow/seed
	44	China Gulch seeding	2,116	Fire/seed
	45	Jaca seeding	2,650	Spray/seed
	46	Chimney Creek brush control	12,180	Spray
	47	Indian Canyon seeding	2,350	Spray/seed
	48	Starvation seeding	13,910	Spray/seed
	49	Frenchman Creek seeding	1,480	Plow/seed
1965	50	Agency Ridge seeding	294	Plow/seed
	51	Hope Butte seeding	2,622	Plow/seed
	52	N.G. Creek seeding	4,593	Plow/seed
	53	Harper seeding	1,155	Plow/seed
	54	North Chicken Creek Maintenance seeding	1,000	Follow up seeding
	55	Cottonwood seeding	4,465	Plow/seed
	56	Lower Clover Creek seeding	1,459	Plow/seed
	57	Lava Ridge seeding	1,000	Plow/seed
	58	Juntura seeding	589	Plow/seed

continued

See footnotes at end of table.

Table 6--*Land treatment projects in the Vale District, Bureau of Land Management, 1952-73*--continued

Year	Number[1]	Name	Acres[2]	Treatment
1965	59	Juniper Basin seeding	692	Plow/seed
	60	Little Valley seeding	691	Plow/seed
	61	Callahan brush control	11,070	Spray
	62	Double Mountain brush control	8,400	Spray
	63	Creston brush control	3,100	Spray
	64	Blue Canyon brush control	10,000	Spray
	65	Little Sandy seeding	2,900	Plow/seed
	66	China Gulch "B" seeding	3,700	Plow/seed
	67	Greeley seeding	4,000	Plow/seed
	68	Bull Creek seeding	3,000	Plow/seed
	69	Beber seeding	870	Plow/seed
	70	Battle Creek seeding	8,800	Plow/seed
	71	Steer Canyon seeding	6,100	Plow/seed
	72	Oregon Canyon brush control	3,186	Spray
	73	Andy Fife brush control	3,540	Spray
1966	74	Mormon Basin "B" seeding	740	Spray/seed
	75	Farewell Bend seeding	1,045	Plow/seed
	76	Bierman Springs seeding	1,440	Plow/seed
	77	Beulah seeding	460	Plow/seed
	78	Radar Hill seeding	1,005	Plow/seed
	79	Westfall seeding	340	Plow/seed
	80	East Cow Hollow seeding	800	Plow/seed
	81	Needham Well seeding	995	Seed only
	82	Slaughter Gulch brush control	12,376	Spray
	83	Mosquito Creek seeding	1,910	Plow/seed
	84	Squaw Creek seeding	980	Plow/seed
	85	Rye Field seeding	3,400	Seed only
	86	Board Corrals brush control	4,350	Spray
	87	Owyhee Canyon brush control	14,000	Spray
	88	Owyhee Butte "B" seeding	300	Plow/seed
	89	Pascoe seeding	1,950	Plow/seed
	90	Field Fire brush control	4,600	Spray
	91	Dry Creek seeding	3,195	Plow/seed
	92	Greeley brush control	2,000	Spray
	93	Rock Creek brush control	2,500	Spray
	94	Black Butte brush control	2,000	Spray
	95	Overshoe Pass seeding	7,345	Spray
	96	Sheep Corrals brush control	2,785	Spray
	97	Oregon Canyon seeding	4,950	Spray/seed
	98	Schoolhouse seeding	3,855	Spray/seed
	99	Flat Top seeding	2,864	Spray/seed
1967	100	Bully Creek seeding	691	Spray/seed
	101	Willow Creek seeding	2,180	Spray/seed
	102	Swamp Creek seeding	1,150	Plow/seed
	103	Lincoln Bench brush control	1,700	Spray
	104	Antelope Flat seeding	1,313	Plow/seed
	105	Spring Creek seeding	2,040	Plow/seed
	106	Big Ridge seeding	3,000	Plow/seed
	107	Field Fire seeding	4,600	Spray/seed
	108	Soldier Creek "B" seeding	280	Plow/seed
	109	Antelope seeding	4,500	Plow/seed
	110	Black Butte seeding	1,655	Plow/seed
	111	Basque seeding	3,200	Spray/seed
	112	Cascade brush control	7,950	Spray
	113	Mine Creek seeding	4,846	Fire/plow/seed
	114	Bretz seeding	2,631	Plow/seed
	115	Angel Canyon seeding	4,247	Plow/seed
	116	Old Jaca seeding	3,874	Spray/seed
1968	117	Hope Flat seeding	1,100	Plow/seed
	118	Meeker Flat brush control	2,520	Spray

continued

See footnotes at end of table.

Table 6--*Land treatment projects in the Vale District, Bureau of Land Management, 1952-73*--continued

Year	Number[1]	Name	Acres[2]	Treatment
1968	119	Saddle Butte seeding	4,106	Spray/seed
	120	Sheepheads seeding	4,392	Plow/seed
	121	Turnbull Lake seeding	7,430	Plow/seed
	122	Shellrock brush control	5,235	Spray
	123	Frank Maher Flat seeding	2,820	Spray/seed
	124	Bankofier seeding	3,610	Plow/seed
	125	Haystack Butte brush control	3,388	Spray
	126	Red Butte brush control	8,340	Spray
1969	127	Buckbrush seeding	850	Plow/seed
	128	North Harper seeding	2,687	Fire/seed
	129	Hunter brush control	10,350	Spray
	130	Quicksand Springs brush control	5,400	Spray
	131	Upper Meadow seeding	540	Plow/seed
	132	Stockade brush control	3,122	Spray
	133	West Crater brush control	11,637	Spray
	134	Spring Basin seeding	1,740	Plow/seed
	135	Spring Mountain seeding	616	Plow/seed
	136	Falen seeding	395	Plow/seed
	137	Barlow brush control	2,833	Spray
	138	Twelve Mile seeding	2,015	Plow/seed
	139	Sheepline brush control	1,345	Spray
	140	Upper Whitehorse brush control	891	Spray
	141	Lazy T Pasture brush control	1,315	Spray
	142	Rim Basin seeding	1,510	Plow/seed
	143	Arritola Reservoir seeding	400	Plow/seed
1970	144	Rufino Butte brush control	10,321	Spray
	145	Rabbit Farm seeding	2,093	Plow/seed
	146	McIntyre brush control	1,050	Spray
	147	Sulfur Springs seeding	1,437	Plow/seed
	148	Summit brush control	3,208	Spray
	149	Jackson Creek brush control	4,750	Spray
	150	Mud Springs brush control	2,013	Spray
	151	Pole Creek seeding	3,010	Spray
	152	Wildcat brush control	6,115	Spray
1971	153	Needham Well seeding	995	Reseed
	154	Freezeout Lake seeding	475	Plow/seed
	155	Carter Creek seeding	3,600	Plow/seed
1972	156	Freezeout Butte brush control	3,535	Spray
	157	Willow Butte seeding	3,310	Plow/seed
	158	Buckskin seeding	4,960	Plow/seed
	159	Fish Creek seeding	5,000	Plow/seed
	160	Boulevard seeding	175	Fire/seed
	161	Baker Creek brush control	4,760	Spray
1973	162	Brassy Mountain seeding	1,675	Fire/seed
	163	Tunnel Canyon seeding	2,500	Fire/seed
	164	Bogus Creek seeding	7,415	Fire/seed

---

[1] Numbers refer to locations in figures 15 and 16.

[2] 1 acre equals 0.405 hectare.

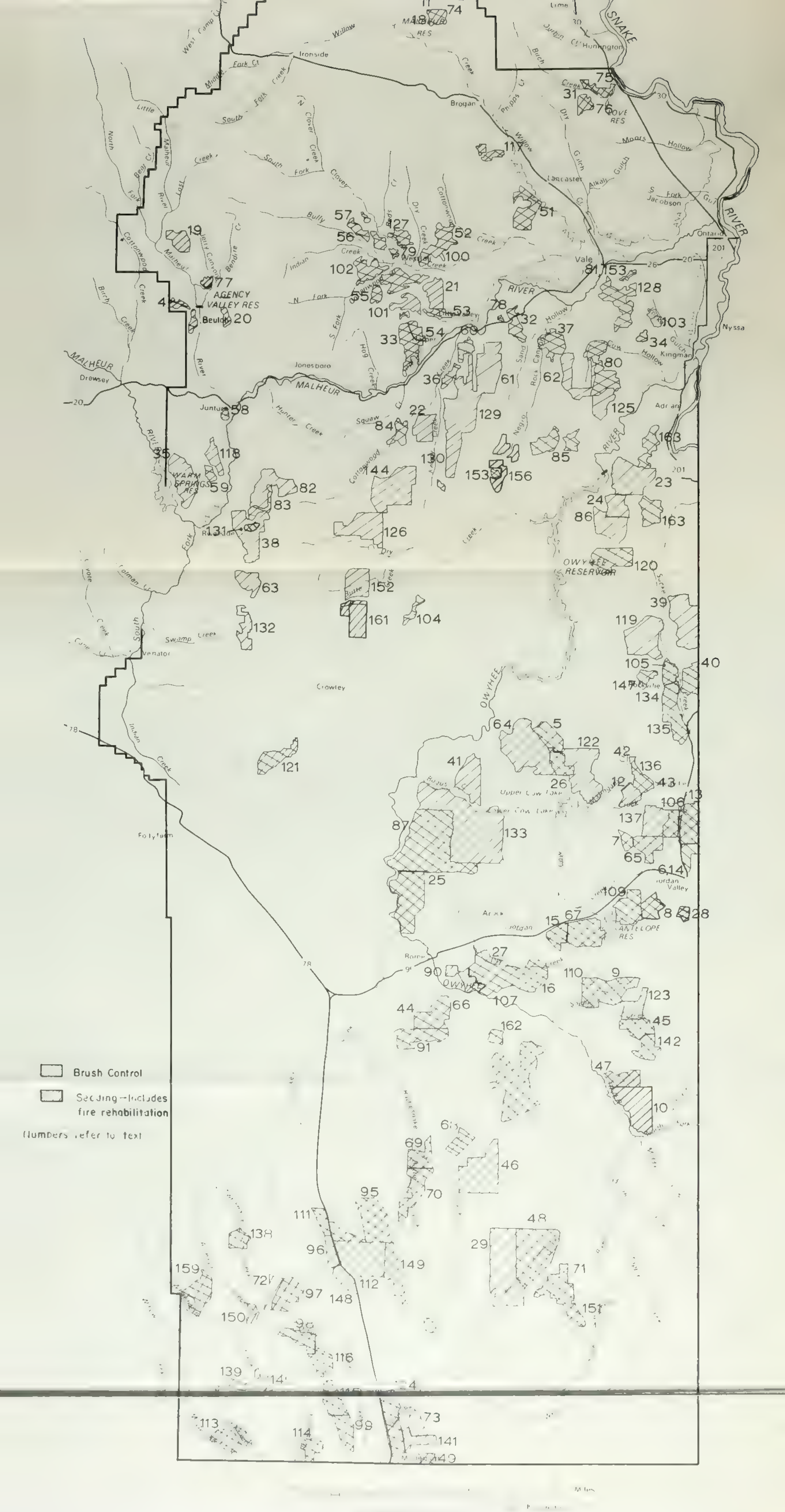


Figure [illegible].--Land treatment projects, [illegible].

Table 7--*Original goals and actual accomplishments of Vale District Program, Bureau of Land Management, through 1973*

Treatment or management aid	Unit[1]	Program goal	Units completed as of 1973	Percent of goal
Brush control	Acres	730,000	[2] 506,570	69
Seeding	Acres	410,000	267,193	65
Fencing	Miles	2,000	1,994	100
Reservoirs	Each	400	583	146
Springs	Each	500	440	88
Wells	Each	100	28	28
Pipelines	Miles	120	462.9	385
Water troughs	Each	640	538	84
Cattle guards	Each	500	360	72
Test plots and exclosures	Each	79	69	87
Costs	Million dollars	16	10	63

[1] 1 acre equals 0.405 hectare; 1 mile equals 1.6 kilometers.

[2] Total brush control acreage; 280,407 acres were control of brush only, not seeded. Some 41,000 acres were seeded without brush control.

The number of projects, acreages, miles of pipelines, number of new watering points, and magnitude of other improvements are subject to considerable interpretation. For example, a few areas underwent several treatments on the same acreage following failures. We treated these as separate projects. In other situations, we were seldom certain whether an acreage was for a pasture or for a treatment that nearly filled a pasture; or if the acreage given was the contracted rather than the completed acreage. Sometimes assumptions of size had to be made in order to evaluate costs, benefits, and grazing capacity. Wherever possible we have chosen to evaluate the overall Vale Program, thereby minimizing, but not eliminating, the importance of accurate data on individual projects. Although some of our data varies from that of others, we have selected what appears to us to be the best available.

The Rangeland Rehabilitation Operation

DISTRICT PLANNING

Planning in the Vale District contributed to the success of the program. Division of the district into three management areas, called resource areas, with separate managers spread the workload and responsibilities. The resource areas were further divided into 14 planning units, which continued to be the bases for planning. Area managers proposed and developed improvement plans, projects, and grazing systems with considerable autonomy. Thus, the mixture of management practices and land treatments differed among the three resource areas. Various differences among the divisions exist today, and they will be discussed in later sections of this report.

Area managers initiated planning and site selection which was consolidated into district plans. The final authority for the coordinated program rested with the district manager who supervised staff personnel responsible for range conservation and development, wildlife management, engineering, watershed protection, land tenure problems, administration, public information, and program coordinations. District personnel include about 75 persons on a permanent basis and another 75 during the field and fire season.

SITE SELECTION

The original program proposed a 2-year survey of 2,660,000 acres (1 000 000 ha) and improvement planning for 4,000,000 acres (1 620 000 ha) to aid in location of land treatments (Bureau of Land Management [n.d.]). Plowing, spraying, seeding, fencing, water development, and other practices were to follow careful planning. Shortly after funds became available, the congressional supporters of the program expressed alarm that the first appropriations of more than $2 million would not show in visible results on the land and that any delay in initiation of rehabilitation could jeopardize future funding. BLM responded by immediately beginning land treatments but with fears that poor site selection would generate habitat damage and ineffective treatment, concerns not supported by the results obtained. Starting in the 2d year of the program, a resource survey enabled site selection to proceed according to plan as modified by the level of funding.

Wisely, the Vale Program proposal required selection of sites for treatment based on their potential for improvement. Sites with greatest potential for improvement were treated first. As funding continued, progressively poorer sites were treated. Local needs for additional forage to satisfy obligated animal numbers did not play a major role in site selection. Likelihood of success determined site selection, not degree of range deterioration.

Although several early Vale Program reports stated that the first land treatment projects, due to pressures for immediate results, directed efforts at the most depleted ranges, records do not bear out that conclusion. Sites treated from 1962 to 1964 had an estimated grazing capacity before treatment of between 21 and 24 acres/AUM (8.5-9.7 ha/AUM), higher capacities than lands treated in later years (fig. 17). The poorest land to be rehabilitated, averaging more than 40 acres/AUM (16 ha/AUM), received treatment in 1967 and 1968. Most areas requiring seeding (preceded by plowing or spraying) and with high site potential had been treated before 1968.

An increased pretreatment grazing capacity in projects after 1968 resulted in part from improved range condition. Native perennial grasses on untreated sites recovered more rapidly than expected, reducing the need for seeding and increasing the effectiveness of spray-only treatments. Two-thirds of the pre-1969 projects (64 of 95) but only one-third (9 of 25) of the post-1968 projects included seeding. Thus, successful early treatment and improved livestock management resulted in a shift in emphasis from plow-and-seed to spray-only. Lack of suitable sites for spraying did not limit the projects from 1969 to 1972. The criteria for site selection and type of treatment changed in 1969 in response to improving range conditions.

The selection of a specific site for treatment and the determination of treatment specifications involved a complex set of factors and criteria, many of which were never formalized or recorded. Primarily, site selection necessitated building the level of judgment by range conservationists to a degree that recommendations were correct biologically and effective managerially. Some of the value judgments that proved effective were: Adequate native perennial grasses as an understory in sagebrush required only a spraying and livestock control to

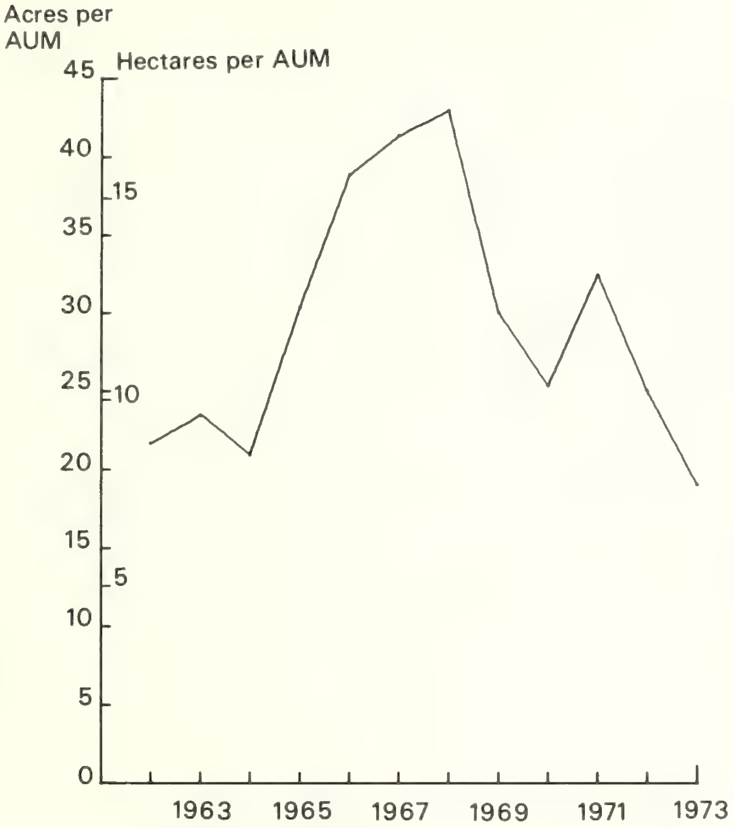


Figure 17.--Estimated grazing capacity for the project areas immediately prior to treatment (source: project site inspection reports).

improve the grass stand; but "adequate perennial grasses" was a value judgment through the early program years. Steeply sloping areas, shallow rocky soils, vegetation with substantial browse for wildlife range, and riparian vegetation were not plowed, seeded, or sprayed.

Range sites with few native perennial grasses and with big sagebrush plants over 3 feet tall indicated high site potential for plowing and seeding. Several criteria of potential success emerged from experiences in the first few projects: (1) Plowing and seeding should be done in areas where few or no perennial grasses occur and where mature big sagebrush is at least 3 feet tall. (2) Spray-only should be done where numerous perennial grasses occur in the sagebrush stands. (3) Spraying in the district should not be combined with plow-seed treatments. (4) Drilling of seed after spraying and without plowing proved effective on some rocky soils and moderately steep slopes. (5) Contract specifications for seed bed preparation are more important than stipulations for percent kill of brush.

Misapplied treatment served to establish these criteria. The native bunchgrasses returned faster than expected. Therefore, some sagebrush sites selected for plowing and seeding could have been sprayed to preserve existing native bunchgrasses. Treatments on old lakebeds frequently failed, and treatments of alkali soils proved unsuccessful.

Considerations of other possible land uses strongly influenced site selection. Beginning in 1963, all land treatment sites were evaluated by the district wildlife biologist and rehabilitation projects were approved by representatives of the Oregon State Game Commission. A few treatments were altered and 11 projects were cancelled to preserve wildlife habitats. Some projects, when executed, did not preserve small areas designated as wildlife habitat due to contractor error and inadequate supervision by BLM personnel. As the program progressed, compatibility between site selection and wildlife habitat requirements improved.

Sixty-nine test plots and exclosures, built before and during the early years of the Vale Program, played a strong role in site selection and stipulation of treatments. Some of the exclosures continue to provide useful vegetational information. Many areas, alkaline soils for example, on which plot responses to treatment were poor, did not show promise for large-scale success and were cancelled from the projects. Conversely, success in plots led to successful projects on areas originally rejected. Test-plot results did not guarantee success. Their use, however, demonstrated the value of pilot tests, a highly important lesson for any large rangeland rehabilitation program.

Uniform distribution of projects (fig. 16) over the district complemented untreated range throughout. Perhaps land treatment projects were concentrated in certain areas and years. At the beginning an extensive rehabilitation program was already underway in the Soldier Creek Management Unit, southwest of Jordan Valley. As additional funds became available in 1962, BLM concentrated its efforts in the Soldier Creek area. Units without significant improvements are Barren Valley in the west-central region of the district, and Star Valley in the remote southeastern portion of the district. Barren Valley has poor potential for improvement, being primarily winter range. The northern part of the district needs additional rehabilitation.

This program shows that rehabilitation on 10 percent or less of the area will result in rapid improvement of the untreated areas through proper management. Thus, the Vale Program dealt with improvement of the whole district, not just the areas plowed, seeded, and sprayed.

Overall, site selection in the Vale District Program was excellent. Problems with particular areas and combinations of treatments did not materially detract from the excellent job of site selection and rehabilitation. Intimate knowledge of the field situations formed the best basis for selection of land for treatment. Even areas treated in the 1st year of the project were successfully improved because of the familiarity of BLM personnel with the range.

BRUSH CONTROL

Methods to reduce the density of shrub species included plowing, spraying, burning, or some combination of treatments. Although not used as a planned treatment, the *Aroga* moth thinned extensive areas of big sagebrush through defoliation.

Plowing with a disk-plow (fig. 18) as a method of brush control became standardized early in the Vale Program, and contract specifications changed little once a few projects showed the relative effectiveness and costs of various treatments. As finalized and used, contracts required plowing to a depth of 4-6 inches (10-15 cm), and an estimated 90 percent kill of brush, which often

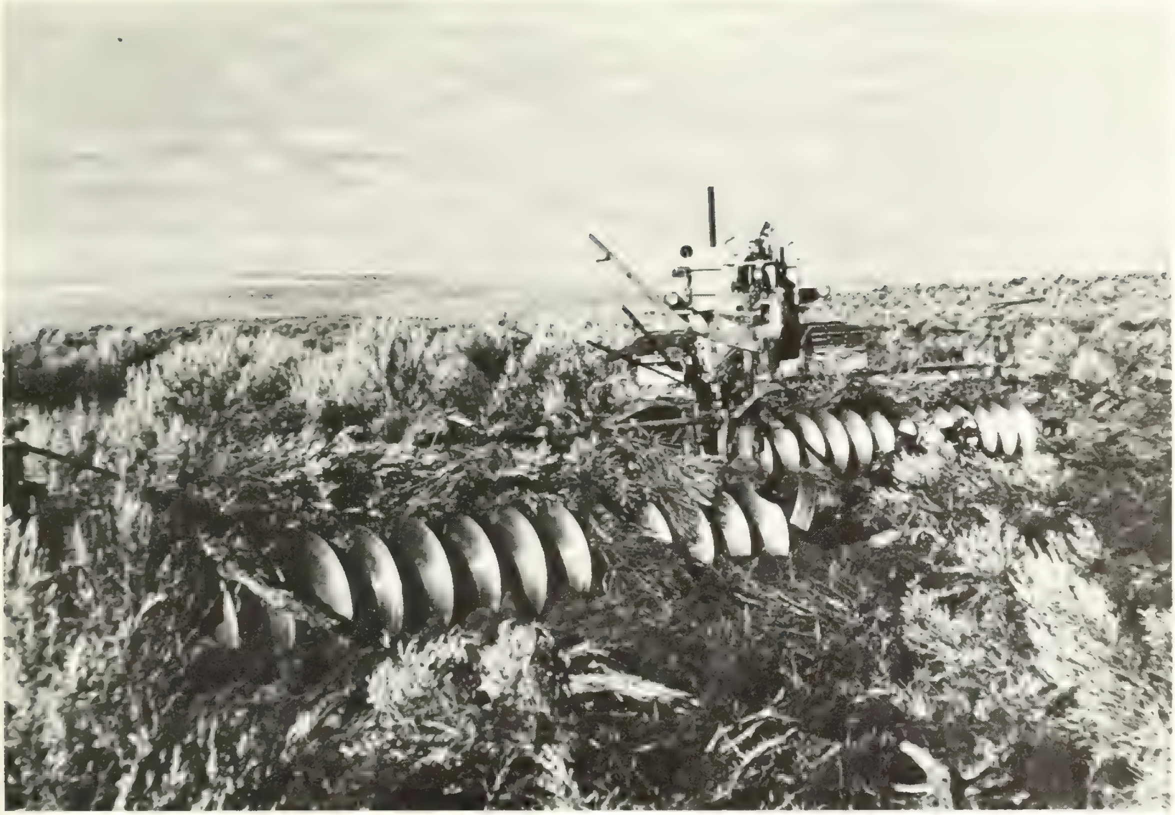


Figure 18.--Removing big sagebrush with a disk-plow (Bureau of Land Management photo). Inquiries concerning design and availability of the latest models of the brushland plow should be addressed to the USDA, Forest Service Equipment Development Center, San Dimas, California 91773.

required two passes over the land. Rangeland plowing generally commenced in late summer or fall immediately prior to seed-drilling time and at the direction of BLM personnel. Timing of plowing operations was not particularly important as a factor in percentage brush kill, but it may have been critical in preventing brush seedling establishment. Plowing after seed of big sagebrush had matured probably fostered big sagebrush regeneration. Primary factors in the success of plowing operations were degree of rockiness, slope percentage, and species of brush. Low sagebrush and rabbitbrush resisted plowing. Plowing contracts were closely supervised, well executed, and generally effective.

Plowing contracts went to the low bidder. If all bids were judged excessively high, budget specifications enabled direct land treatment by BLM. A successful contractor furnished labor, the power for pulling government-owned brushland plows, and all necessary maintenance of equipment. Costs of plowing varied greatly due to site and increased from the low figures during early years of the program.

Effects of spraying herbicides to control brush varied much more than plowing. Contractors applied the specified spray mixture at certain rates over designated areas (fig. 19). Although BLM personnel closely supervised most spray operations and aided in field applications, contractor compliance with specifications was less easily accomplished and policed than plowing.

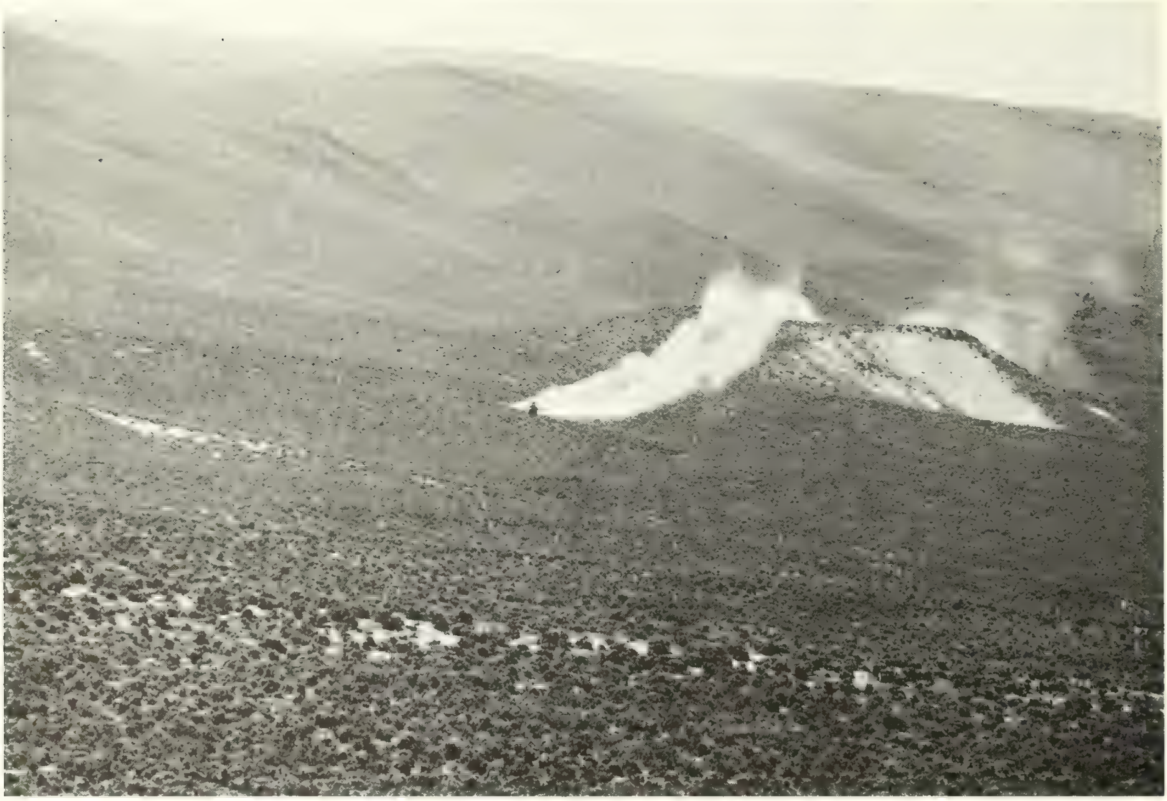


Figure 19.--Spraying long strips of big sagebrush tends to cross steep slopes and streams, which should not be sprayed (Bureau of Land Management photo).

The herbicide used, 2,4-D, and the rate, 2 lb acid equivalent per acre (2.2 kg/ha), did not change throughout the program. Many successful controls of big sagebrush had been obtained in other places, so experiments with types of herbicides and rates of application were not required. The herbicide carrier and timing of application significantly affected percentage kill and hence, the effectiveness of particular spray operations. In most cases, 2,4-D with a diesel oil carrier killed big sagebrush. Environmental considerations caused substitution of water for diesel oil in 1965, which made accurate timing of application critical. Poor kills of big sagebrush resulted from spraying in 1965 and 1966; however, the water-based herbicide killed brush even better than herbicide with diesel oil base when specifications were followed. Application of 2,4-D was usually made by fixed-wing aircraft, but occasionally by helicopter.

Every contract for spraying specified that the timing of the operations was to be regulated by BLM. Soil moisture and plant phenology, as originally recommended on the Squaw Butte Experiment Station by Hyder and Sneva (1955), were used to indicate the season for spraying. Heading of Sandberg bluegrass and rapid spring growth indicate onset of effective spraying conditions. Sufficient soil moisture (more than 8 percent) for an adequate kill of big sagebrush remains until half the bluegrass leaves have dried. The officer in charge controlled the day-to-day progress of the operation. Spraying was halted any time that winds exceeded 10 miles per hour (16 km/h). The timing of operations for maximum kill of big sagebrush often resulted in unsatisfactory kill of rabbitbrush.

Several spray projects suffered from inadequate compliance with contract specifications, such as the West Crater brush control in which inadequate overlap of spray-runs resulted in alternate strips of killed and unkilled brush.

The Lodge brush control project in 1964 serves as an example of the procedures in a spraying operation (Irons 1964). District personnel were in charge and monitored both spraying the site and loading the aircraft. Three flagmen marked the spray-runs, and they used two-way radios and four-wheel drive vehicles to keep in line. The contractor used two converted TBM torpedo bombers of World War II vintage, each capable of carrying 700 gallons (3 100 liters) of spray. He also furnished the spray mixture consisting of 2 lb acid equivalent 2,4-D in 3 gallons of diesel oil per acre (2.2 lb in 11 liters/ha). Thus, each aircraft covered approximately 233 acres (95 ha) per trip. Samples of the spray mixture were taken by BLM personnel at the airport for analysis. Each trip involved 20 minutes of flying time from the Homedale airport and 3 minutes for loading. The aircraft flew at an altitude of 50 feet (15 m), and spray-runs were 190 feet (58 m) wide. Spray extended over a strip 400 feet (120 m) wide, giving excellent herbicide overlap. This operation covered 6,500 acres (2 630 ha) between 4:45 a.m. and 4:20 p.m. on May 15, 1964, at a cost of $2.10 per acre ($5.20/ha). Winds stayed below 10 m/h (16 km/h), otherwise the operation would have been halted. Temperature rose from 29 °F (-2 °C) in the morning to 65 °F (18 °C) in the afternoon. Soil moisture was 12 percent. The resulting kill of brush was excellent.

Wildfires frequently followed land treatments, especially sprayings; and all or part of several projects were swept by fire. Burning further increased the effectiveness of brush control and left no detectable detrimental effects on forage for livestock after the 1st year. Removal of grazing for a year following treatments permitted fuel to accumulate, thus favoring fires. Wildfires which burned independently of brush control treatments also effectively killed sagebrush. Burned areas have the lowest average density of sagebrush of any treatment.

An outbreak of *Aroga* moths killed sagebrush in several areas during the early 1960's just as the Vale Program began. They did not kill significant amounts of sagebrush (fig. 20). A single project located in the Cherry Creek drainage was cancelled as a result of *Aroga* kill of sagebrush. The moth may strip parts of the brush of leaves, but kill seldom exceeds 10 percent of individual shrubs.

SEEDING

Seeding followed a variety of land treatments. All plowed land and some of the sprayed areas were seeded (fig. 21). The plowing, mostly for brush control, also reduced cheatgrass and other herbaceous competitors and prepared a seed bed. Seeding usually followed wildfire and failures from previous rehabilitation attempts without site preparation by plowing.

Decisions concerning particular practices and whether or not to seed at all depended on test plots and ocular site evaluations. Species tested in plots included crested wheatgrasses, pubescent wheatgrass (*Agropyron trichophorum*) tall wheatgrass (*A. elongatum*), western wheatgrass (*A. smithii*), yellow sweetclover (*Melilotus officinalis*), and other clovers (*Trifolium* spp.). Crested wheatgrass seldom failed in the plots, and the other plant species seldom succeeded. The standard seeding became 7 lb/acre (8 kg/ha) of crested wheatgrass with a rangeland drill--specifications not significantly modified throughout the program. The seed,

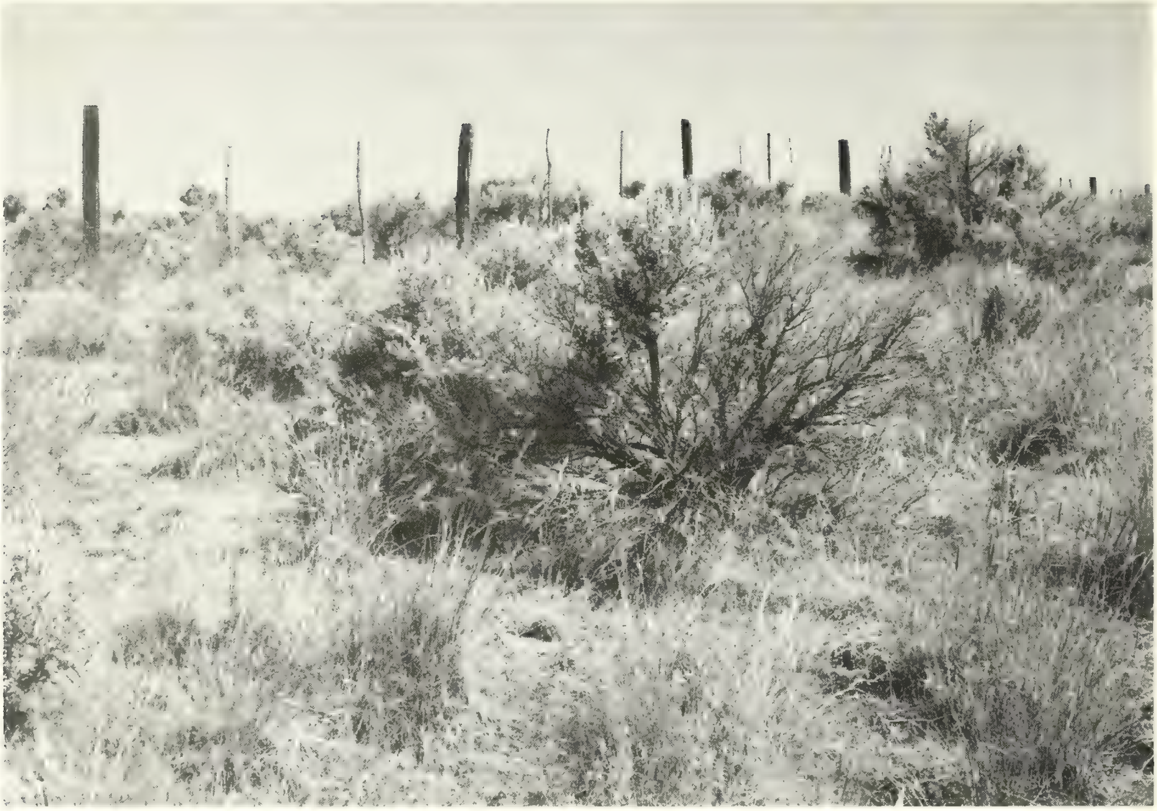
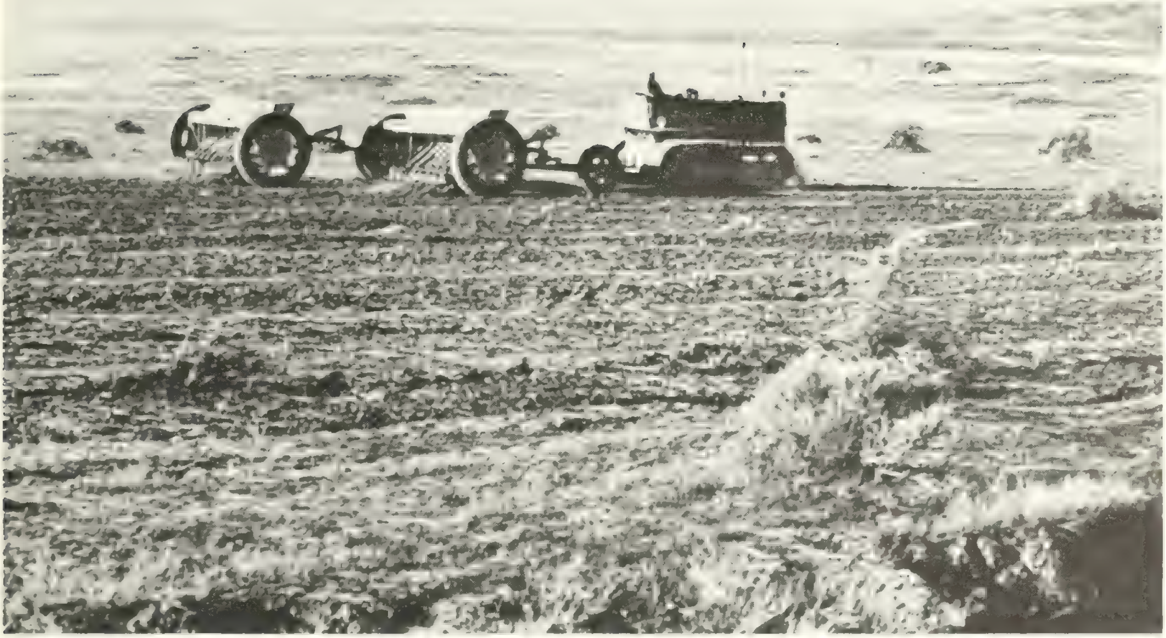


Figure 20.--The moth Aroga *seldom kills the whole bush of big sagebrush plants.*

purchased annually in large commercial lots, consisted of mixed Standard (*Agropyron desertorum*) and Fairway (*A. cristatum*) crested wheatgrass; at least that was the appearance of most stands in 1975.

Alkaline soils, shallow rock soils, and a vegetative cover of low sagebrush indicated marginal sites for seeding of crested wheatgrass. Other species of grasses and legumes were also planted on such sites. On a mud flat or dry lakebed, for example, pubescent wheatgrass at 1.5 lb/acre (1.7 kg/ha), western wheatgrass at 2.6 lb/acre (2.9 kg/ha), tall wheatgrass at 0.75 lb/acre (0.85 kg/ha), crested wheatgrass at 2 lb/acre (2.3 kg/ha), and strawberry clover (*Trifolium fragiferum*) at 0.33 lb/acre (0.37 kg/ha) constituted the seed mixture. Immediately after that treatment, the seeding contained mainly crested wheatgrass; but by 1975 pubescent wheatgrass dominated, with only about 5 percent crested wheatgrass. Nomad alfalfa (*Medicago sativa*) was seeded on 56,340 acres (22 800 ha) by air in the spring following fall drilling to crested wheatgrass (fig. 22).

Seeding practices drew heavily on methods developed during the 1950's at the Squaw Butte Experiment Station near Burns, Oregon, and limited experience in range seeding on the Vale District before the start of the Vale Program. An early seeding, the Soldier Creek project (fig. 15, number 2), which was plowed with a Wheatland disk-plow in the fall of 1955 and broadcast seeded with crested wheatgras at a rate of 6.25 lb/acre (7.1 kg/ha) in the fall, failed because of cheatgrass competition. The area has a complex later history of burning and reseeding attempts. The Soldier Creek project cost $13.58/acre ($33.53/ha) for seeding, plowing, water development, and fencing.



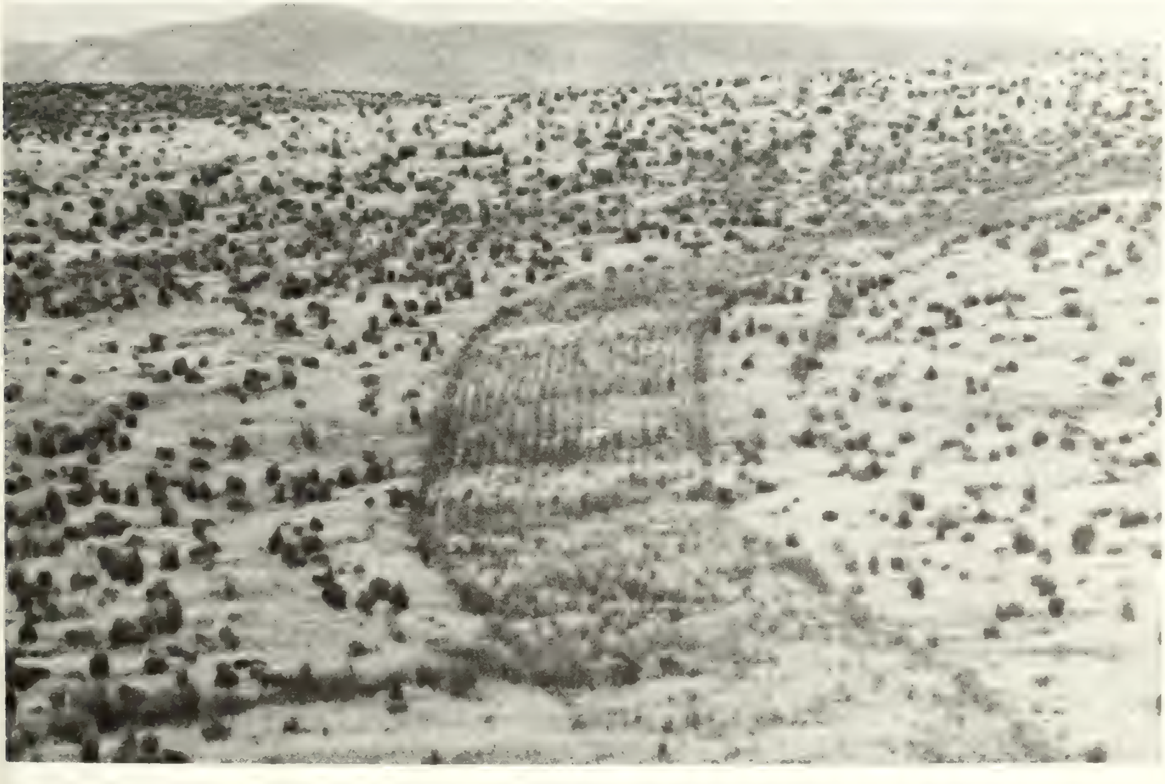


Figure 21.--Top, drilling crested wheatgrass (Bureau of Land Management photo). Bottom, a poor stand of crested wheatgrass in cheatgrass after a burn and broadcast seeding. The good stand from the single pass of the drill demonstrates the need for drilling. Inquiries about the rangeland drill should be addressed to the USDA, Forest Service Equipment Development Center, San Dimas, California 91773.

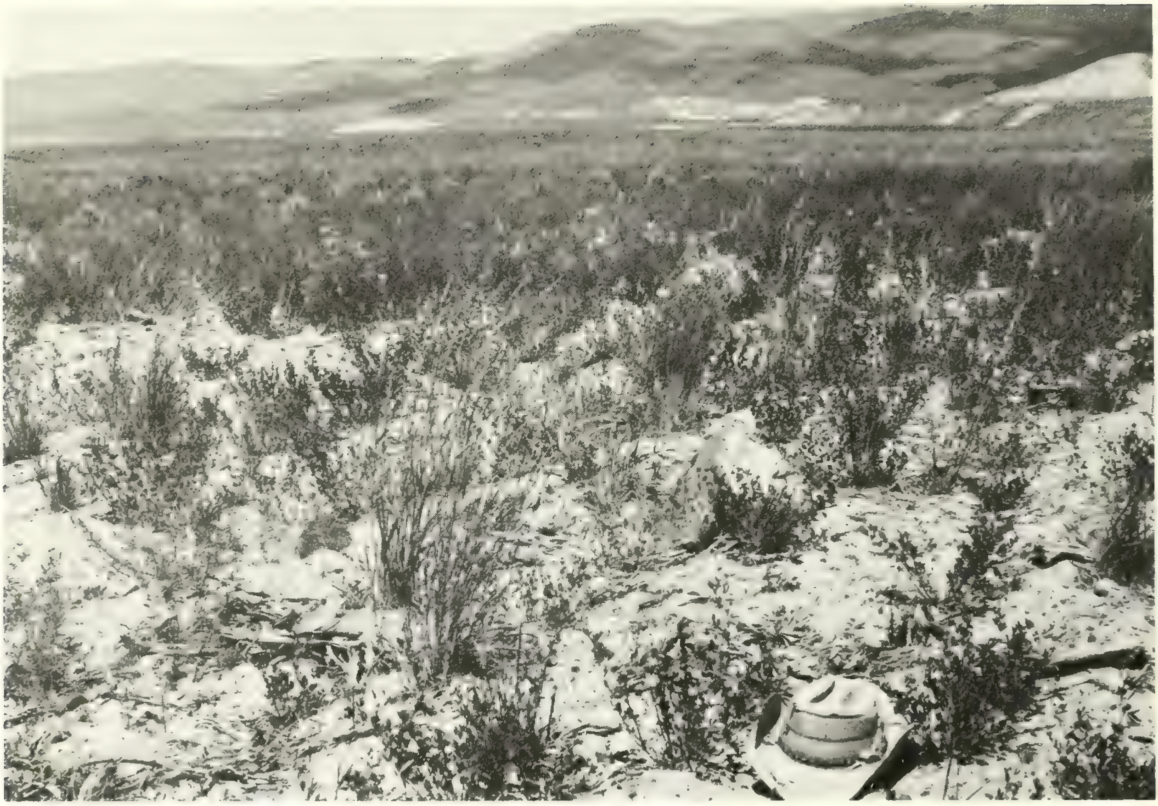


Figure 22.--A stand of nomad alfalfa and crested wheatgrass (photo, courtesy of R. Kindschy, Bureau of Land Management, Vale, Oregon).

Contract procedures for seeding became standardized in 1962. An example is the Sheep Springs project which was plowed twice with Wheatland plows in the fall of 1962 and seeded to crested wheatgrass at 8.5 lb/acre (9.6 kg/ha) in November of 1962 on partially frozen soils. Costs averaged $14.94/acre ($36.89/ha) for 605 acres (245 ha). A second example is the Gluch project which was sprayed with 2,4-D in diesel oil at 2 lb/acre (2.2 kg/ha) from a helicopter in April 1961. Areas in the project lacking in grass cover were drilled with crested wheatgrass at 5.5 lb/acre (6.2 kg/ha) in November 1961. Fencing enclosed 9,107 acres (3 688 ha) of which 5,450 (2 207 ha) had been sprayed and 3,567 acres (1 445 ha) seeded. Average cost was $5.77/acre ($14.25/ha).

FIRE

Fire, as an ecological and historical factor, has been mentioned repeatedly in this report without discussion of its role in the district operations. The original program budget included $314,000 for fire protection. The Vale District fire control program became large, effective, and the headquarters for widely used hotshot crews--the Snake River Valley firefighters--which service other areas. Planning and preparation for control take place in the winter and additional personnel are hired in the summer for detection and suppression of fire. When fires pose threats to valuable resources, structures, livestock, habitations, etc., they must be suppressed. After a wildfire, rehabilitation becomes an emergency project to be accomplished with haste.

The goals of the Vale Program stipulated that fire control, specifically the replacement of highly flammable cheatgrass with less hazardous perennial grasses, would be increased in effectiveness. Other benefits to fire suppression would include access roads, reduction of big sagebrush cover, and additional water sources. The Vale Program would incur costs for fire control because of needs to protect investments in land treatments, specifically seedings. Fire control was not considered a management tool nor the burned areas opportunities for rehabilitation.

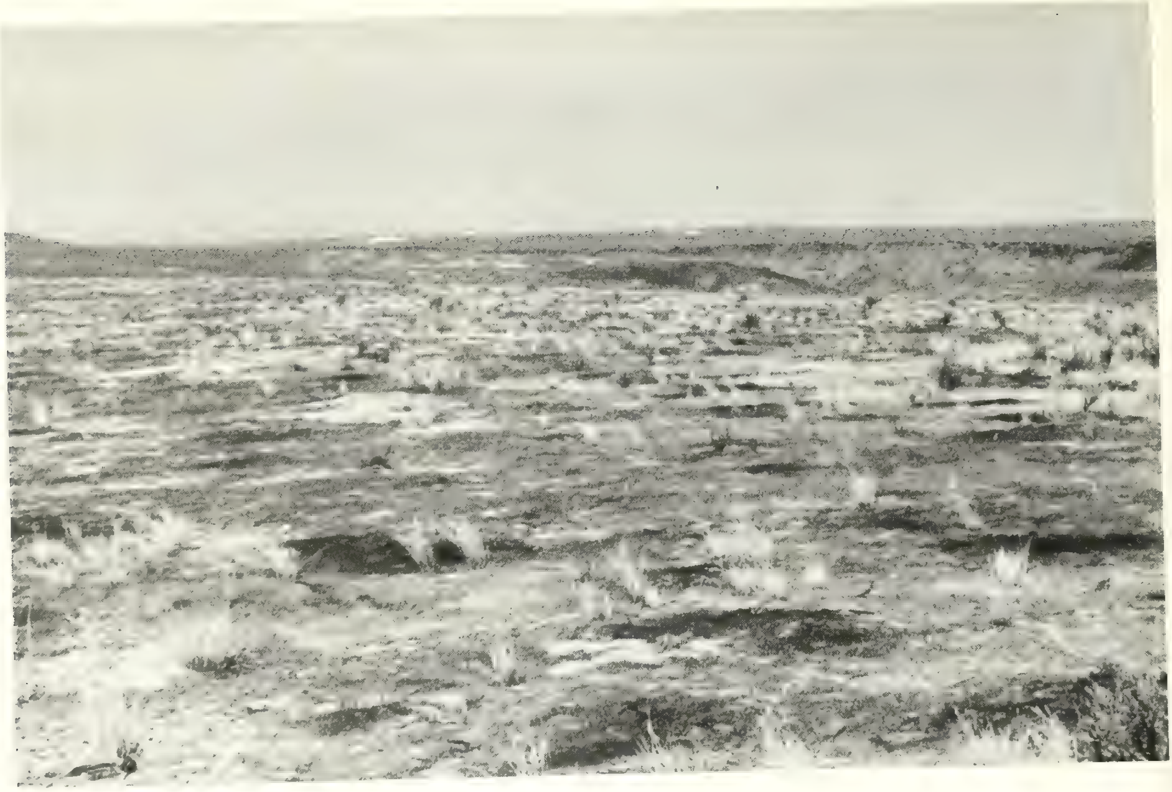
Rangeland fires have persistently caused controversy over costs, damages, and benefits of burning. The ready availability of funds for wildlife suppression and rehabilitation, and conflicting goals in land management contribute to continuing disagreements. To illustrate, hundreds of thousands of dollars are spent annually in the Vale District for fire suppression (table 8); yet burned and rehabilitated lands produce as much forage as the acceptable but more expensive plowed-and-seeded areas. Perennial grasses are encouraged because they reduce the high fire hazard of cheatgrass, yet an abundance of perennial herbage with rest from grazing creates high fuel volumes on some pastures. These and other conflicting situations do not yield to simple solutions in planning for proper rangeland rehabilitation and use.

Table 8--*Costs for fire protection and fighting fire on the Vale District, Bureau of Land Management, 1972-76*

Fiscal year	Protection	Firefighting
	Dollars	
1972	66,500	523,700
1973	67,467	924,555
1974	88,540	786,963
1975	105,178	707,558
1976	89,840	470,478

In hindsight, the dismissal of fire from the Vale District Program as a land treatment was a mistake. The district's present emphasis on fuel management in brush types of vegetation and the recognition of the natural role of fire in the big sagebrush-grass ecosystems have established the development of prescribed fire as a legitimate land management practice. At the beginning of the Vale Program, however, fire was considered both harmful and dangerous, which it is if uncontrolled.

Historically, fires in the Vale area were a result of lightning strikes or were set by Indians. Peter Skene Ogden mentioned fires along Bully Creek which Indians set in 1827 (Williams et al. 1971). Such fires did not eliminate big sagebrush nor the perennial bunchgrasses (Uresk et al. 1976), but they created a mosaic of big sagebrush and grass of varying proportions, densities, and ages. The big sagebrush at any given time probably did not exceed 25-percent cover. Due to overgrazing, the unrehabilitated range now has the introduced cheatgrass, much more big sagebrush, and less perennial grass than the vegetation before livestock grazing. The addition of cheatgrass caused the flammability and fire hazard to increase (fig. 23).



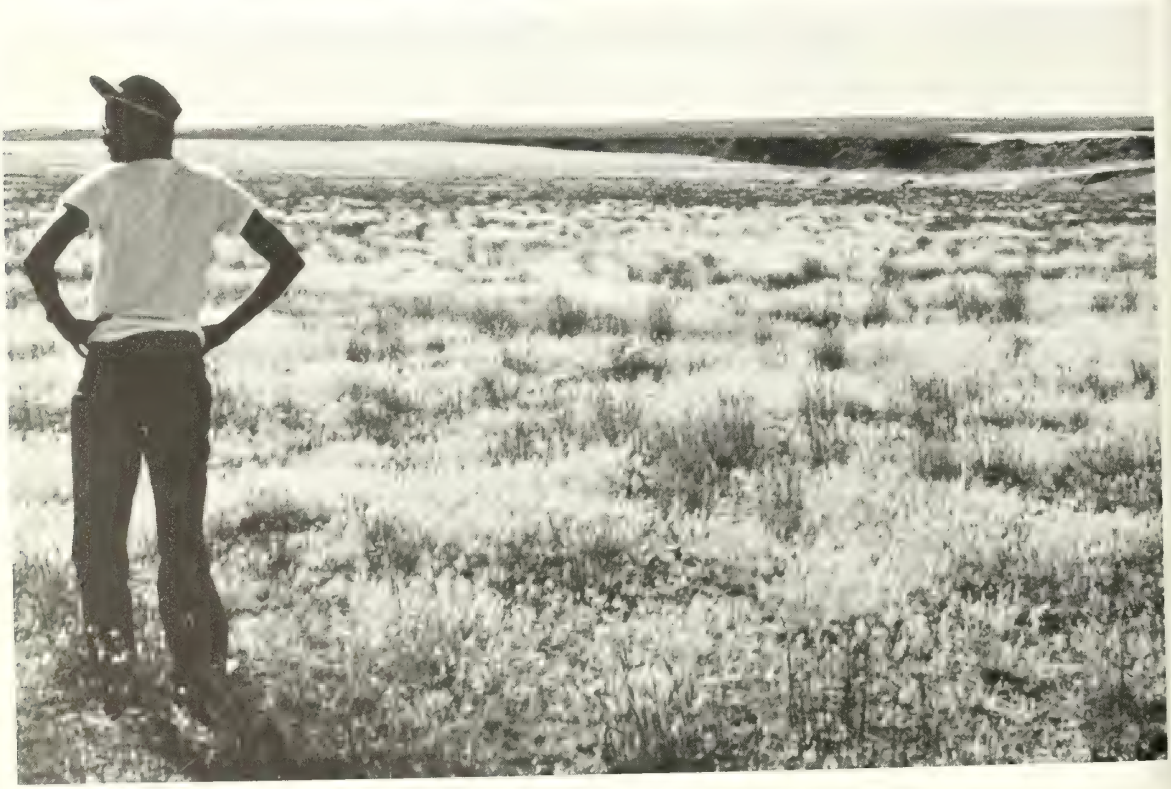


Figure 23.--Top, a fire burned this area in 1975; bottom, the same area in 1976. Crested wheatgrass did not burn as readily as the annual cheatgrass. Apparently cheatgrass and crested wheatgrass survived the fire with little damage.

Where the bunchgrasses are abundant, especially where their density exceeds an average of three plants/yd^2 (3.6 plants/m^2), cheatgrass is reduced or nearly eliminated, thus reducing a major source of fuel for range fires. Big sagebrush alone will burn and so will the bunchgrasses; but fires in vegetation without cheatgrass spread less rapidly and are easier to control. Therefore, fuel management should aim for reduction of cheatgrass and an increase in the perennial grasses with less big sagebrush. This reduction is in harmony with proper range management for other purposes.

Where native perennial bunchgrasses remain, even as scattered as 10 yards (9 m) between plants, proper livestock use will encourage establishment of thick stands which will reduce fire hazards. Where extreme overuse has eliminated perennial grasses, reseeding will be needed.

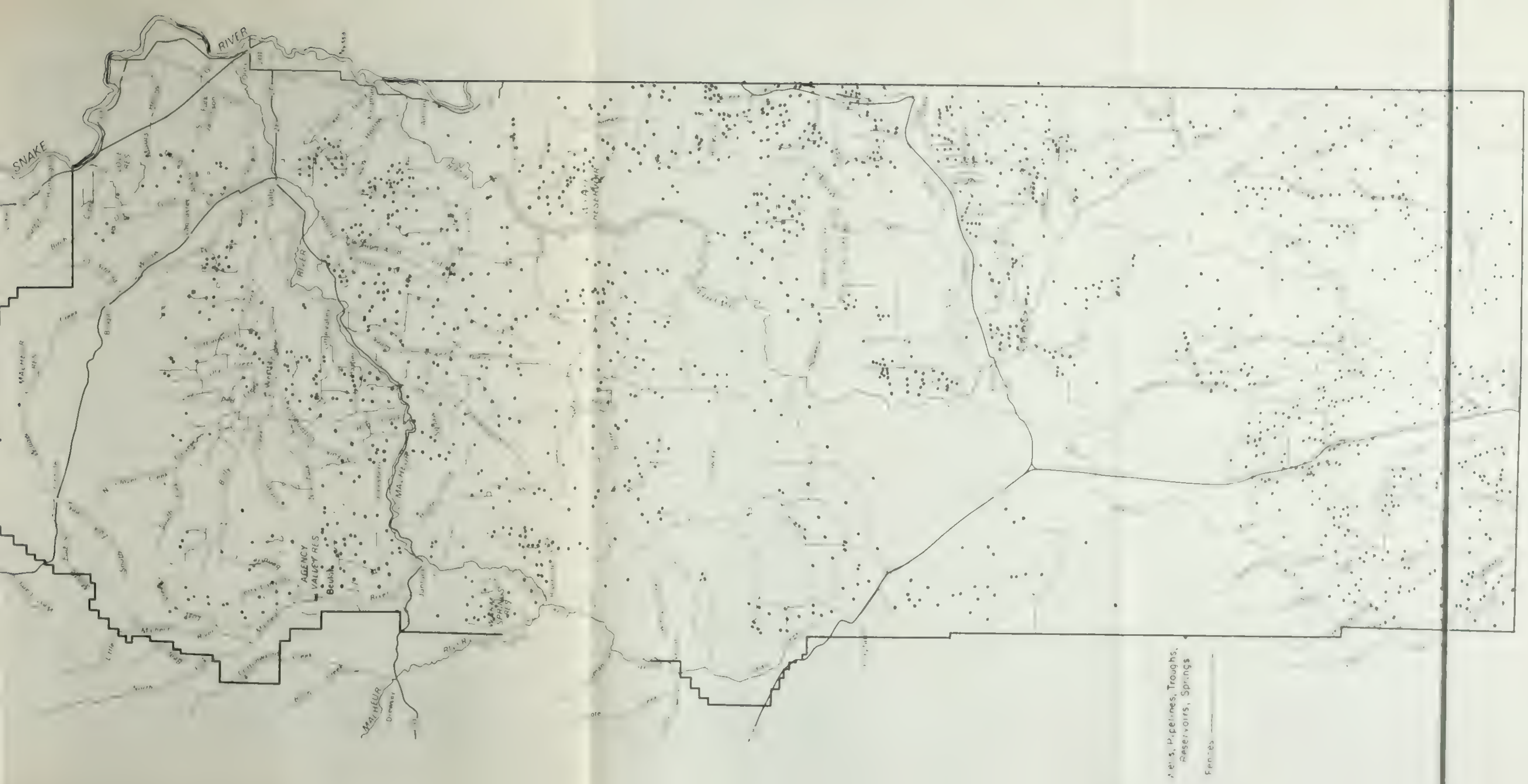
A well-designed management plan for large areas will have a few strategically placed perennial grass seedings which will allow other areas to rehabilitate through natural succession to perennial grass codominance with big sagebrush. When wildfires occur, any necessary seeding can be done. A wildfire should be viewed as a land treatment or site preparation and as an opportunity for range rehabilitation.

Fuel management aims to make fire suppression more effective than at present and to facilitate other uses. In big sagebrush-grass, fuel management must be coordinated with changes in botanical composition caused by defoliation, grazing, and wildfire. Cheatgrass, a high fire-hazard fuel, is not sufficiently defoliated by grazing animals to reduce the hazard. Cheatgrass can be reduced in most areas through proper grazing management which favors perennials. Fires which reduce big sagebrush also can favor the succession to perennial grass. Big sagebrush and perennial grasses should be managed as fuels and as forage in the integrated system. The pasture, then, is the logical management unit for both as it is already under controlled grazing use. Roads as fuel breaks should be used only where pastures do not make adequate fuel management units.

Ideal management of big sagebrush-perennial grass takes advantage of all alternative types of manipulations and uses. Fuel management affects the vegetation and the uses made of that vegetation. Grazing management, mechanical brush control, spraying, and seeding also affect vegetation *and* fuel management. The original Vale District Program considered fires as catastrophes. A fuel management program would risk perpetuating that attitude if people from all disciplines were not included from the beginning of planning. Fuel management, including the use of prescribed fire, has much to offer as an effective tool for rangeland rehabilitation, especially as a replacement for spraying with herbicides. Ecosystem considerations are essential.

WATER DEVELOPMENTS, FENCES, AND ROADS

Most range rehabilitation operations should include provisions for improvements in livestock management by increasing water, fences, and roads (fig. 24). Roads were difficult to evaluate because much of their utility was neither measured nor described. If an unimproved road existed and was graded, the access improved for only certain types of vehicles, perhaps cattle trucks; yet large areas in the district need no roads for accessibility for some types of vehicles. The permanence of a road constructed in conjunction with a range improvement project varied from quick abandonment after a project to one improved and maintained for general use.



SNAKE
RIVER
RIVER
MALHEUR
RES
AGENCY VALLEY RES
Beulah
WARM SPRINGS RES
MALHEUR
RIVER
Wells, Pipelines, Troughs, Reservoirs, Springs
Fences

Newly constructed fences and watering points, even though they benefited uses other than livestock grazing, facilitated use of all the rangeland. Seedings required fencing to insure their protection and use as special pastures, and seasonal grazing systems needed pastures. That usually necessitated new watering points. Location of fences depended on the characteristics of the pasture and the needs for animal management. A typical pattern utilized natural barriers and existing fences as outer allotment boundaries and the new fences as cross-fences. Usually, a large crested wheatgrass seeding would be divided in anticipation of an alternating spring turnout grazing system. In this system, a pasture would be grazed first in one year and second the following year. Seldom did the occurrence of free water fit the needs of livestock in these pastures. A total of 2,081 miles (3 348 km) of fences on the Vale District were built by the BLM to standards which allowed antelope passage under the lowest wire. Since 1971, users have maintained the fences. Six hundred miles (960 km) of fence were constructed, largely by ranchers, before the program began.

Two basic types of water development were used. One created reservoirs in suitable locations within pastures (fig. 25). During the course of the Vale Program, 624 such reservoirs were constructed. They had a high probability of failure to hold water for the full grazing seasons. Many were planned as sources of water for spring use of crested wheatgrass turnout pastures. This limited summer and fall use; consequently much effort went into the second type of development--reliable sources of year-round water, specifically wells, pipelines, and troughs. During the Vale Program (table 9), 28 such systems were built. A typical system used a well drilled at a location to produce sufficient water and in a place where gravity feed could be used to supply water to troughs. Propane-powered pumps, maintained by the BLM, kept water in an 18,000-gallon (65 000-liter) tank in each well system. From each centrally located tank, water flowed through buried plastic pipe by gravity to fill individual stockwater troughs. Many such troughs were made from discarded jet engine shipping containers (fig. 26). Spring developments numbered 448 during the Vale Program (table 9). The 2,000 miles (3 200 km) of fence and 1,600 watering points, plus those installed before the program started, fulfilled the original project goal.

ERRORS AND LACK OF COMPLIANCE WITH CONTRACTS

An undertaking with the scope in acreage and treatments of the Vale District Program cannot be without errors. Errors resulted from lack of knowledge, lack of experience, and lack of compliance to job specifications. A discussion of these problems may be useful for other rehabilitation programs.

One benefit was that plowing left patches of brush, irregular borders, and a mosaic of vegetation, because the machinery could not operate on steep slopes and rocky areas. Spraying by air, however, covered the landscape completely. Spraying tended to convert larger and more continuous blocks than plowing. Aerial brush control requires more careful attention to siting and ground flagging than does plowing. Such control was not always accomplished in the Vale Program.

Although contracts were carefully written, they were not always carefully followed. Some examples serve to illustrate the need to have continuous field supervision. Sprayings in a few instances killed big sagebrush in strips because of improper flagging or cheating on the contract. Some sprayings extended over areas that should not have been sprayed. In one instance the seed of intermediate wheatgrass was used when the contract called for crested wheatgrass.

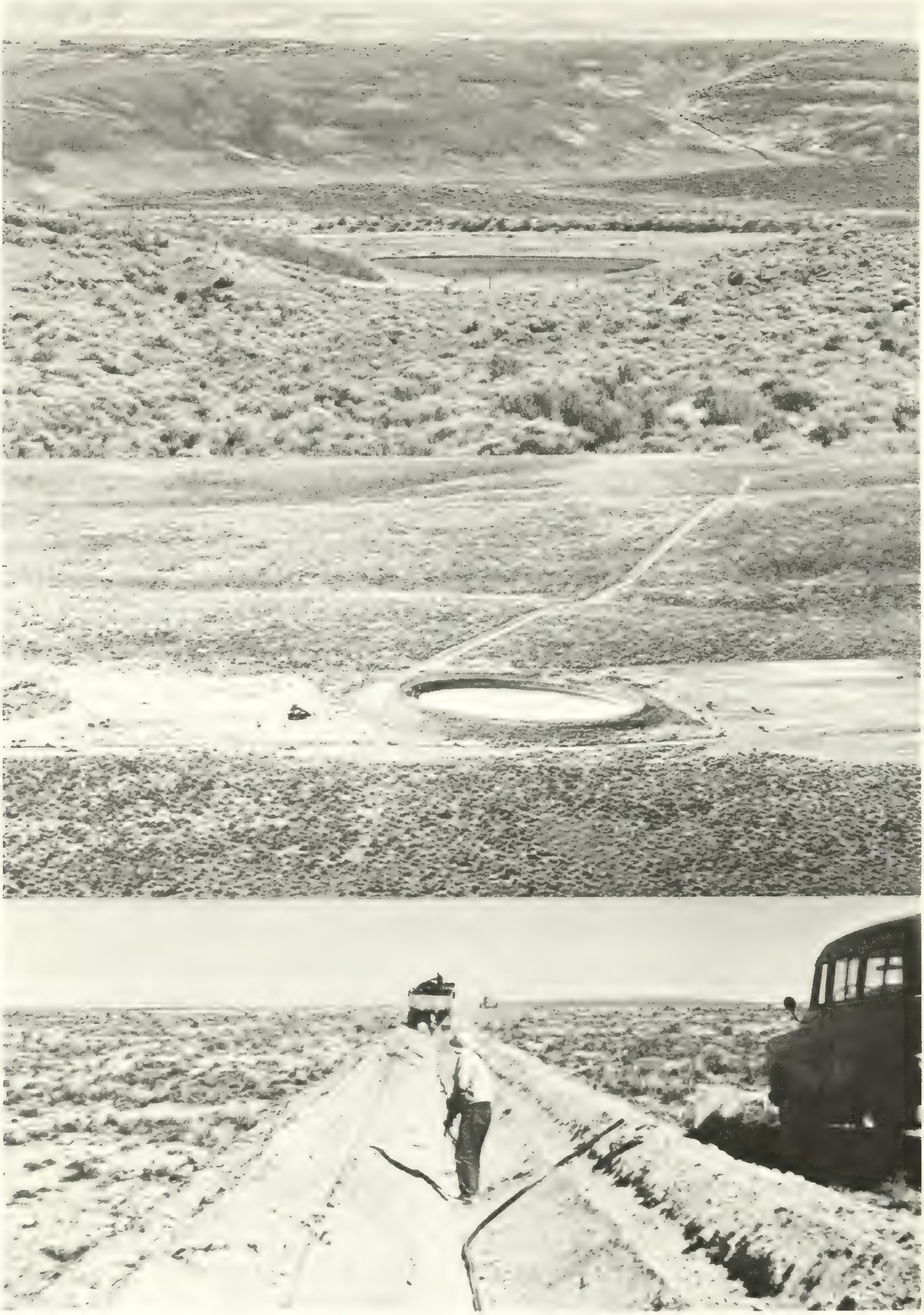


Figure 25.--Commonly, one type of water system starts with a reservoir (top), water piped to a storage tank called a noodle-bowl (middle photo by Bureau of Land Management), and buried pipeline to troughs (bottom photo by Bureau of Land Management).

Table 9--*Wells, pipelines, other water developments, and fences in the Vale District, Bureau of Land Management, 1940-75*[1/]

Years	Wells	Pipeline	Reservoirs	Springs	Troughs	Total	Fences
		Miles	- - - - - - - -	Number	- - - - - - - -		Miles
1940-60	12	0.2	413	119	1	533	596.7
1961	0	0	41	8	0	49	87.7
1962	0	21.4	9	11	28	48	108.2
1963	2	12.8	24	17	20	61	80.5
1964	2	--	13	62	--	75	181.0
1965	1	9.0	54	49	13	116	175.9
1966	1	28.7	44	43	35	122	56.2
1967	1	38.4	52	30	39	121	277.3
1968	0	142.0	169	59	152	380	461.3
1969	7	28.6	69	52	44	165	269.8
1970	5	82.5	36	44	85	165	141.1
1971	3	28.6	31	11	39	81	87.3
1972	5	30.6	16	32	41	89	64.0
1973	1	10.9	15	2	11	28	35.6
1974	0	7.7	33	19	11	63	42.8
1975	0	21.7	18	9	20	47	12.6
Total, 1961-75	28	462.9	624	448	538	1,610	2,081.3
District total	40	463.1	1,037	567	539	2,143	2,678.0

[1/] 1 mile equals 1.6 kilometers.

Siting and developing of watering points did very well for livestock, but these same developments variously affected wildlife habitats. Before development, many small springs had wet areas, small meadows, and associated fauna that were destroyed when all the water was collected into tanks and troughs. The smaller animals find watering at a trough difficult or impossible. Even though chukar partridge, sagegrouse, and quail can water at properly built troughs, their foods provided by the meadows are gone. Overflow water should be piped to fenced sites to create new meadows. A few of these new meadows in the Vale District have produced larger wildlife sites than the original meadows.

Provision for watering and safety of small animals at livestock watering troughs need imaginative engineering. Few troughs have satisfactory designs for smaller animals. The design of troughs for livestock and the large game animals also needs consideration.

Fence design and construction show few errors. The standards used, a four-strand wire fence with the bottom wire 18 inches (46 cm) and the top strand 42 inches (107 cm) above the ground, allow the free movement of antelope and mule deer. A new fence should be flagged with a white cloth between every post to make it obvious to antelope. Fence surrounding study exclosures should have two additional wires with stiles substituted for gates.

CONTINUED UPKEEP AFTER THE VALE PROGRAM ENDED

The users pay fuel costs to operate the water systems; maintenance of pumps, tanks, troughs, and pipelines is BLM's responsibility. BLM also maintains

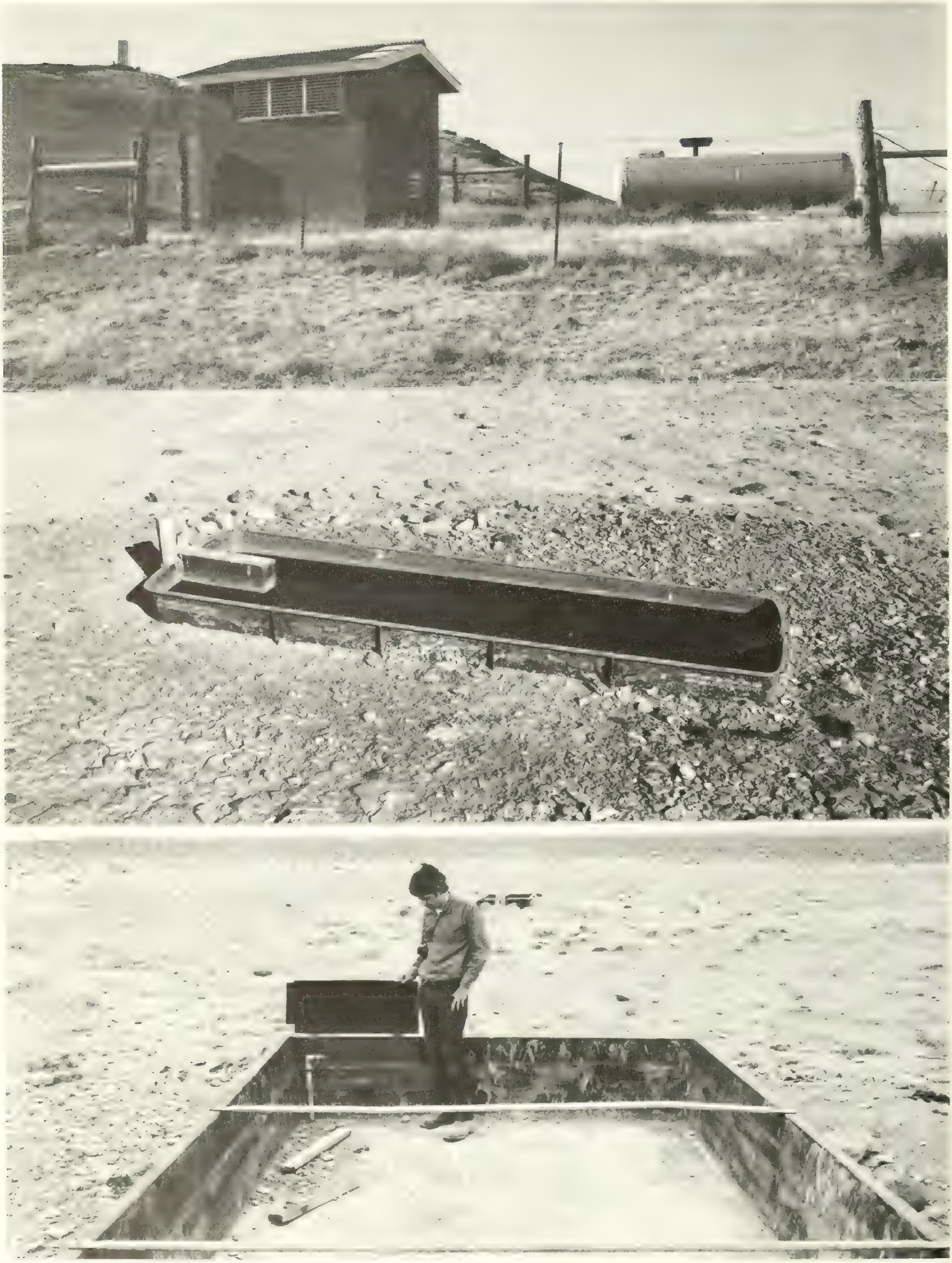


Figure 26.--A second type of water system uses a well and butane-operated pump, a metal storage tank on the hill (top), and pipeline to troughs (middle). The large shallow trough (bottom) stores water and permits cattle to escape if they fall into the trough.

reservoirs and springs on public lands. Maintenance personnel and the permittees continually monitor water supplies; many of the water systems are examined from low-flying aircraft every 2d or 3d day during the grazing season. Much of the maintenance budget is used to keep the water systems operating. Since livestock are critically dependent on water, the systems must be continually monitored. A failure in 1972 resulted in cattle dying of thirst, controversy over responsibilities, and unfavorable publicity.

The permittees maintain fences but BLM replaces them. Fences last many years before they need replacement. BLM repairs the roads. Since 1973, the Vale District has concentrated on maintenance of the facilities developed during the program and continued vegetational improvement, essentially through management of livestock grazing. For the most part, the action has been aimed at the holding of gains, protection from fire, and some rehabilitation after wildfires, rather than new and expanded projects.

The costs of the Vale Program go beyond initial establishment. Maintenance of improvements continues to be expensive. Thus, any cost-benefit evaluation of the program on a long-term basis must include continuing costs. Imperfect data are available for those costs, even for investments in the program itself, because accounting has not separated costs of rehabilitation projects, maintenance, and other operating expenses. Rough estimates of these costs are possible when funding of the Vale District is compared with that of the adjacent Burns BLM District. The largest single annual allocation for range improvement to the Vale District was $1,406,000 in 1965, but funding was over $1 million annually from 1964 to 1968. During that period, the Burns District received approximately $200,000 per year (table 10). The Vale Program formally ended with fiscal year 1973, by which time funding for the district had dropped to $538,875. The budgets for 1974 and 1975 were $503,081 and $530,025, respectively. In contrast the Burns District received only $120,000 for range improvements in fiscal year 1973 and

Table 10--*Estimated costs of the Vale Program, fiscal years 1962-73*

Fiscal year	Range management, soil, and watershed		Base budget for Vale	Program funds for Vale
	Vale District	Burns District		
			$1,000	
1962[1]	107.5	103.2	107.5	0
1963	918.7	149.0	155.0	763.7
1964	1,116.0	195.0	205.0	911.0
1965	1,159.3	241.0	245.0	914.3
1966	1,332.3	283.0	295.0	1,037.3
1967	1,406.9	273.6	285.0	1,121.9
1968	1,369.3	284.0	292.0	1,077.3
1969	1,079.2	209.2	215.0	864.2
1970	1,072.4	224.3	234.0	786.4
1971	794.9	251.1	260.0	534.9
1972	792.5	211.5	208.0	584.5
1973	666.9	200.3	205.0	461.9
Total	11,656.4	2,521.7	2,599.0	9,057.4

Source: Bureau of Land Management State and District Office records.

[1] 1962 gives pre-Vale Program funding level and is not included in the total.

$270,000 in 1975. Thus, the difference of $260,000 between Vale and Burns Districts adjusted downward by 25 percent because of the size difference in the districts, yields an estimate of $195,000 per year in added maintenance costs which must be attributed to the Vale Program. BLM resource lands in the Burns District total 3,500,000 acres (1 400 000 ha) which support 265,000 AUM's; in the Vale District they total 4,600,000 acres (1 860 000 ha) which support 420,000 AUM's.

Grazing Management

PERMITTED GRAZING LOAD

Animal unit months of forage provided on the Vale District are largely the outcome of customary practice. There is little accurate analysis of either the ultimate capacity of the land to produce forage or of the forage-producing capacity of dependent property. Before 1934, unfenced public domain was free to anyone who ran livestock. After the passage of the Taylor Grazing Act, a user of the public domain had to establish a right to obtain a permit and to pay for the grazing use. Two categories of permits were established by the act. Class I permits for a certain number of AUM's depended on use of the public lands during the 5 previous years, and the number of animals which could be supported by local private property for 5 winter months. Class II permits were to be granted after all Class I permits had been filled. Class II permits required the independent private property commensurability but did not require the establishment of prior use on public land. In 1934 there was no way of knowing how much actual forage could be provided by the public domain; thus, all Class I and most of the Class II applications were granted. In the beginning, the Vale District provided the amount of forage to permittees with commensurate property that they had historically used. It took 2 years for all permits to be issued; therefore, permitted numbers increase from 146,193 AU's in 1935 to 122,322 AU's in 1936 (table 11).

Forage provided in AUM's increased from 255,900 in 1935 to 412,618 in 1936 and continued to increase, reaching a maximum of 504,024 in 1955. The peak in 1955 was approximately a 20-percent increase from the late 1930's. As described earlier in this report, the advisory board on the Vale District in effect regulated permitted animal numbers until the late 1950's. At that time, the BLM won a series of battles with livestock users and began to assert control over livestock use on the Vale District and elsewhere. Range surveys conducted during the 1950's showed that the range was overobligated to the point that proper use of some areas on the Vale District would require 50-percent cuts in permitted use. To avoid this reduction by restoring forage production was the principal motive for the Vale Program.

The first districtwide estimated grazing capacity, 285,000 AUM's, was made in 1961. In that year, 427,476 AUM's were licensed (table 12). Cattle and horses consumed 96 percent of the forage, sheep only 4 percent.

As the Vale Program developed, grazing capacity increased. Within the separa projects, the permittees took temporary nonuse in lieu of a permanent reduction of permitted grazing and the promise that temporary nonuse would be restored. Estimated grazing capacity for the district as a whole first exceeded actual use in 1972 (table 12).

Although these data are the best available, they can be misleading. First, as mentioned above, demanded forage or permitted numbers stem from the historical

Table 11--*Licensed numbers of animal unit months of grazing and animal units, Vale District, Bureau of Land Management, 1935-75*

Year	Animal unit months	Animal units
1935	255,900	146,193
1936	412,618	122,322
1937	346,980	114,113
1938	457,360	111,972
1939	424,231	106,662
1940	418,594	90,638
1941	424,070	90,446
1942	406,649	110,091
1943	414,718	108,595
1944	399,903	109,110
1945	442,454	113,070
1946	468,121	117,678
1947	459,751	105,891
1948	489,718	122,717
1949	458,294	121,032
1950	448,895	118,854
1951	484,800	107,439
1952	458,124	102,969
1953	468,728	110,416
1954	467,111	108,474
1955	504,024	111,695
1956	491,311	114,249
1957	483,539	181,673
1958	489,971	107,708
1959	415,737	[1]88,811
1960	439,013	100,920
1961	427,476	98,559
1962	400,663	92,743
1963	399,386	86,435
1964	409,726	85,676
1965	411,285	87,024
1966	419,567	88,166
1967	392,481	75,698
1968	422,414	80,910
1969	426,024	83,829
1970	407,152	[1]72,805
1971	418,010	72,676
1972	416,248	77,640
1973	417,207	75,504
1974	432,394	77,493
1975	415,383	75,868

[1] The drops in licensed use resulted from Vale District boundary changes.

granting of permits which was largely determined through negotiations and not by measurement of the capacity of the land. Thus, increased grazing capacity from 1961 to 1974 signifies that the rangeland now has the capacity to produce what has been used throughout that period. Area range conservationists provided the grazing capacity data in table 12, and they based the estimates on impressions of overuse and underuse. No planned grazing capacity surveys were made.

Second, district data mask variations. Forage beyond that being used exists in the southern part of the district while parts of the northern resource area received heavy use each year. Therefore, former cuts in Class I permitted numbers are being restored in the south but not in the north. Some range users are still

Table 12--*Licensed grazing use by livestock and estimated grazing capacity in the Vale District, Bureau of Land Management*

Year and class of livestock[1]	Licensed numbers	Licensed AUM's of use	Estimated grazing capacity, available AUM's
1961:			
Cattle and horses	89,624	409,691	
Sheep	44,679	17,785	
Total	134,303	427,476	285,000
1962:			
Cattle and horses	81,461	[2]	
Sheep	56,409	[2]	
Total	137,870	400,663	343,000
1963:			
Cattle and horses	79,963	389,306	
Sheep	32,518	10,080	
Total	112,481	399,386	285,000
1964:			
Cattle and horses	79,016	399,211	
Sheep	33,301	10,515	
Total	112,317	409,726	300,000
1965:			
Cattle and horses	78,456	401,201	
Sheep	42,841	10,084	
Total	121,297	411,285	350,000
1966:			
Cattle and horses	82,061	410,316	
Sheep	30,525	9,251	
Total	113,586	419,567	300,000
1967:			
Cattle and horses	68,332	384,895	
Sheep	36,828	7,586	
Total	105,160	392,481	331,000
1968:			
Cattle and horses	75,160	417,180	
Sheep	28,748	5,234	
Total	103,908	422,414	340,000
1969:			
Cattle and horses	79,584	419,237	
Sheep	21,225	6,787	
Total	100,809	426,024	373,000
1970:			
Cattle and horses	67,904	400,858	
Sheep	24,505	6,294	
Total	92,409	407,152	383,000
1971:			
Cattle and horses	67,646	411,729	
Sheep	25,050	6,281	
Total	92,696	418,010	414,000
1972:			
Cattle and horses	74,160	411,374	
Sheep	17,400	4,874	
Total	91,560	416,248	419,000
1973:			
Cattle and horses	73,264	413,361	
Sheep	11,200	3,846	
Total	84,464	417,207	423,000
1974:			
Cattle and horses	75,893	429,623	
Sheep	8,000	2,771	
Total	83,893	432,394	435,000
1975:			
Cattle and horses	74,388	411,873	
Sheep	7,400	3,510	
Total	81,788	415,383	438,000

[1] Excludes wild horses.

[2] Data not available.

operating under reductions in Class I permits while others are not able to use all the forage produced.

Many reasons exist for the differences, including less rainfall in the north, a longer history of rangeland abuse, allotment herds composed of mixed dairy and beef animals, common use allotments with animals from several owners, failures in cooperative management by numerous permittees with few animal units, frequent changes in permittees, and a more complicated mixture of landownerships in the north than in the south. Individuals find herd improvements difficult to attain, and the group allotments remain difficult to manage. Allotments with large pastures, however, require less fencing, fewer water developments, and are easier to administer than small areas. Some reallocation of grazing has been done, but redistributing grazing use to fit available forage remains one of the critical problems facing Vale BLM administration.

SEASON OF GRAZING USE

Most of the Vale District is generally considered spring range. Water and green forage are then abundantly available and animals put on the best gains. Wildlife, however, use rangeland at all seasons, and livestock can use it whenever weather permits (fig. 27 shows actual use). Few areas are used yearlong. Areas well supplied with palatable browse, especially the desert shrub type, are used in the winter by livestock. The area of sagebrush-grass, which encompasses most of the public lands, is used in spring, summer, and fall. The typical permitted grazing season on Federal lands is 7 months long, April through October. Within that grazing season, the grazing period in any pasture follows a particular management system. For example, many areas are not grazed in the fall to preserve browse for wintering wildlife. Lack of water restricts use to spring and early summer. In other places elevation restricts fall use, and convenience to the home ranch results in repeated seasonal use of a few pastures.

GRAZING SYSTEMS

Within the season of grazing use--that time during which grazing is feasible--animals often graze different pastures. The grazing period is defined as the time when livestock actually graze a pasture. It may be as long as the grazing season, or it may be considerably shorter. The pattern of grazing one to several pastures within the grazing season constitutes a seasonal grazing system. The term "grazing system" implies many possible combinations of grazing periods during which grazing is systematically regulated and controlled. Grazing systems require an organized framework for understanding. Table 13 shows the wide variety of seasonal grazing treatments practiced with 144 pastures in 29 systems. The Vale District has many more pastures and systems not formalized in allotment management plans.

The simplest grazing system keeps the animals in one pasture throughout the grazing season. This season-long use has been the historic pattern of livestock use on public lands in the West and continues on many areas today. Much overuse and range deterioration have been blamed on season-long grazing with little thought being given to other faulty range management practices. Thus, efforts toward improvement of range livestock management have usually started with elimination of season-long grazing. The initiation of an allotment management

Table 13--*Number of pastures for 29 grazing systems by type of management and season of use, Vale District, Bureau of Land Management*

Type of seasonal use	Native	Seeded	Total
Summary of 29 grazing systems:			
Number of pastures[1]	105	39	144
Turnout to 6 weeks into season (about Apr. 1 to May 15)	63	39	102
Spring until seed ripening (about May 15 to July 15)	89	31	110
After seed ripening, deferred (about July 15 to Sept. 1)	75	24	99
Fall (about Sept. 1 to Oct. 31)	59	21	80
Winter (Nov. to March)	4	0	4
Rest (no grazing in a year)	40	5	45
2 consecutive years of rest	6	3	9
Pastures with repeated seasonal use, no rotation at any season:			
Number of pastures[1]	9	6	15
Turnout to 6 weeks into season (about Apr. 1 to May 15)	4	6	10
Spring until seed ripening (about May 15 to July 15)	1	0	1
After seed ripening, deferred (about July 15 to Sept. 1)	1	4	5
Fall (about Sept. 1 to Oct. 31)	2	4	6
Winter	1	0	1
Pastures with repeated seasonal use in at least one season, rotation in some other season:			
Number of pastures[1]	27	20	47
Turnout to 6 weeks into season (about Apr. 1 to May 15)	0	0	0
Spring until seed ripening (about May 15 to July 15)	0	0	0
After seed ripening, deferred (about July 15 to Sept. 1)	27	20	47
Fall (about Sept. 1 to Oct. 31)	20	4	24
Winter	0	0	0
Pastures with rotation of seasonal use	96	33	129
Pastures with "switchback"[2] system of turnout on crested wheatgrass and deferment of native range (two grazing systems with 11 pastures)	7	4	11
Pastures with crested wheatgrass treated the same as adjacent native range (seven grazing systems with 45 pastures)	24	21	45

[1] Not a total of seasonal treatments because some pastures are used more than once.

[2] Alternating forest grazing among two pastures in succeeding years.

by BLM in recent years has been almost synonymous with the establishment of some kind of grazing system other than season-long grazing. Yearlong grazing is not practiced on Vale District lands.

Repeated seasonal grazing describes use that occurs at the same season each year. On the Vale District, repeated seasonal grazing may be spring, late spring, after seed ripening, fall, winter, or some combination of these times. About 15 percent of the pastures studied received only repeated seasonal grazing.

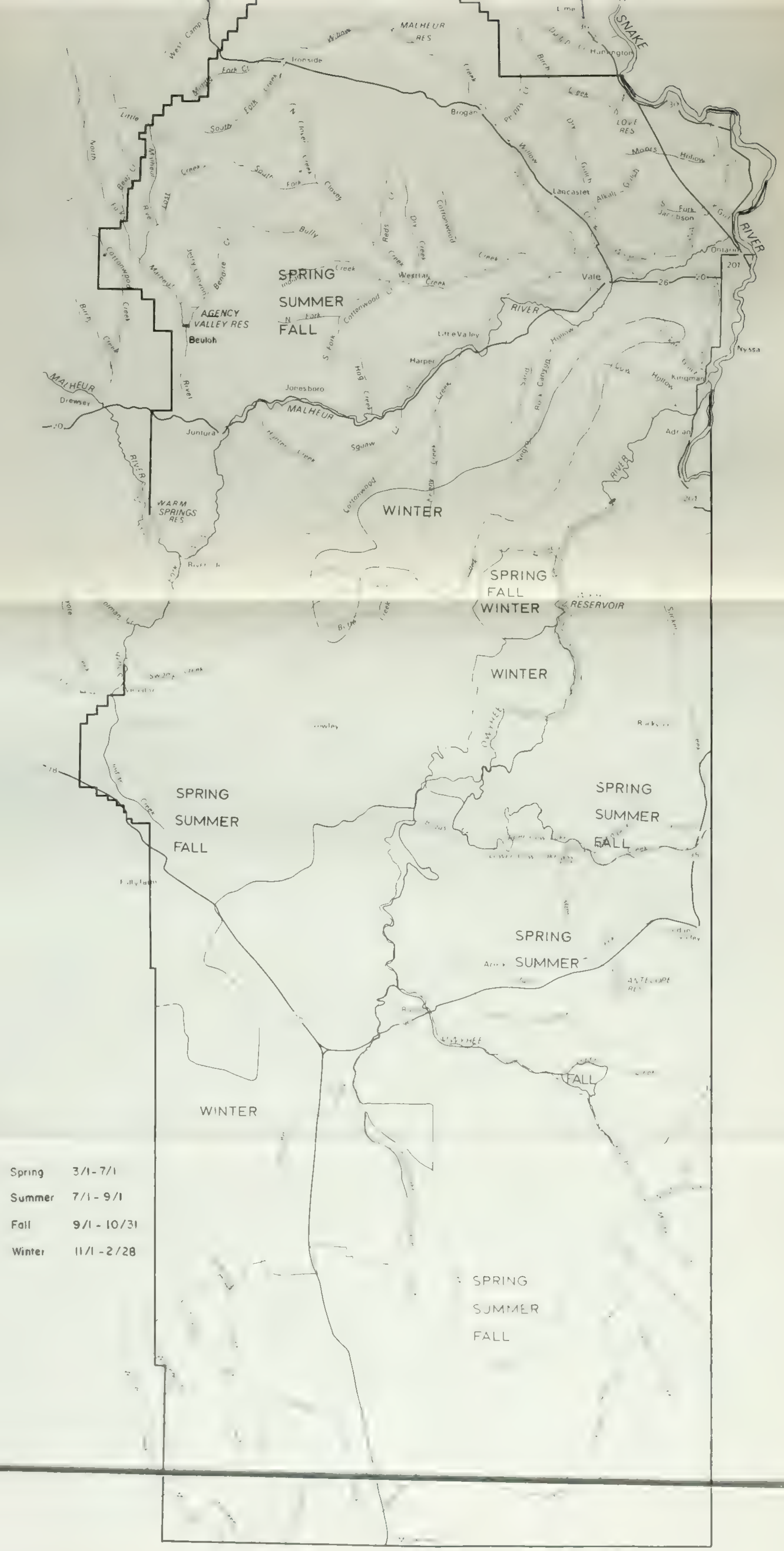


Figure [illegible].- Seasons of use.

Nine were native range and six were crested wheatgrass. Of the 15 pastures so grazed, 8 received repeated grazing at more than one time each year (table 13). Reasons for repeated seasonal grazing included adequate stock water only in the spring season, crested wheatgrass grazed early to defer native range, need to facilitate animal husbandry practices, and proximity to the home ranch. Repeated fall grazing reduced trailing and permitted gathering of animals before winter storms. In a few instances early fall removal preserved bitterbrush for wildlife. An additional 47 pastures received repeated grazing after seed ripening as well as some form of rotational grazing before seed ripening. None of these pastures failed to improve in range condition during the program.

The third main category of grazing systems involved rotation of seasonal grazing--the modification of the pattern of grazing in succeeding years (fig. 28). Patterns took a wide variety of designs with all seven seasonal periods of grazing rotated in innumerable combinations (table 13). Rotational grazing is said to avoid damage to vegetation caused by repeated grazing at the same time each year. We found the pastures grazed in the same season every year to be in as good range condition as those grazed on a rotational basis. The systems aim to improve range conditions by fostering seedling establishment of desirable species. Rotational systems will not be described in all combinations but a typical example would be a native range allotment which is divided into several pastures. A different pasture would not be grazed until after seed ripening each year. Another system would begin with grazing on a pair of crested wheatgrass pastures, which would be followed by a rotation on native ranges. The crested wheatgrass pastures would be alternated in consecutive years. This system delays turnout onto native ranges and rotates early use of the seeded pastures. Rotational grazing was practiced on 129 pastures.

Allotment management plans early in the program established deferred-rotational systems on native range. Many of these systems have changed. At the inception of the Vale Program it was envisioned that crested wheatgrass seedings would primarily serve for deferment of native ranges. Turnout onto crested wheatgrass every spring, with a switchback between two pastures in alternate years, would permit late spring use of native range. In 1975 that arrangement persisted in only 2 of 29 sampled allotments. Although all crested wheatgrass seedings are still used for turnout, at least in some years, most are treated like native bunchgrass range. Twenty-one of 39 seeded pastures were managed identically to adjacent native range. Another recent modification involves the use of identical treatments for 2 years rather than 1 in the rotational cycle. Resting, or no grazing at all, for 2 consecutive years occurred on nine pastures, six native and three seeded, about 6 percent of the pastures in our sample. The most notable change in seasonal grazing practice has been the tendency to use the seedings and the native ranges in the same manner.

All grazing systems provide for flexibility in dates of grazing and numbers of animals to deal with variability in water supply, forage quantity, and inclement weather. Large variations from the written plans indicate day-to-day decisionmaking in the grazing of the national resource lands, as should be the case. A few plans which include large proportions of private land in mixture with public land give the users responsibility for management of animals, and the BLM range conservationist serves only in an advisory capacity. This arrangement encourages user responsibility for the range and it should be encouraged as the range improves.

The grazing systems originally established aimed to protect and use the crested wheatgrass seedings, to rehabilitate the native ranges, and to preserve browse for wildlife. For those objectives yearlong rest and little early grazing on the native

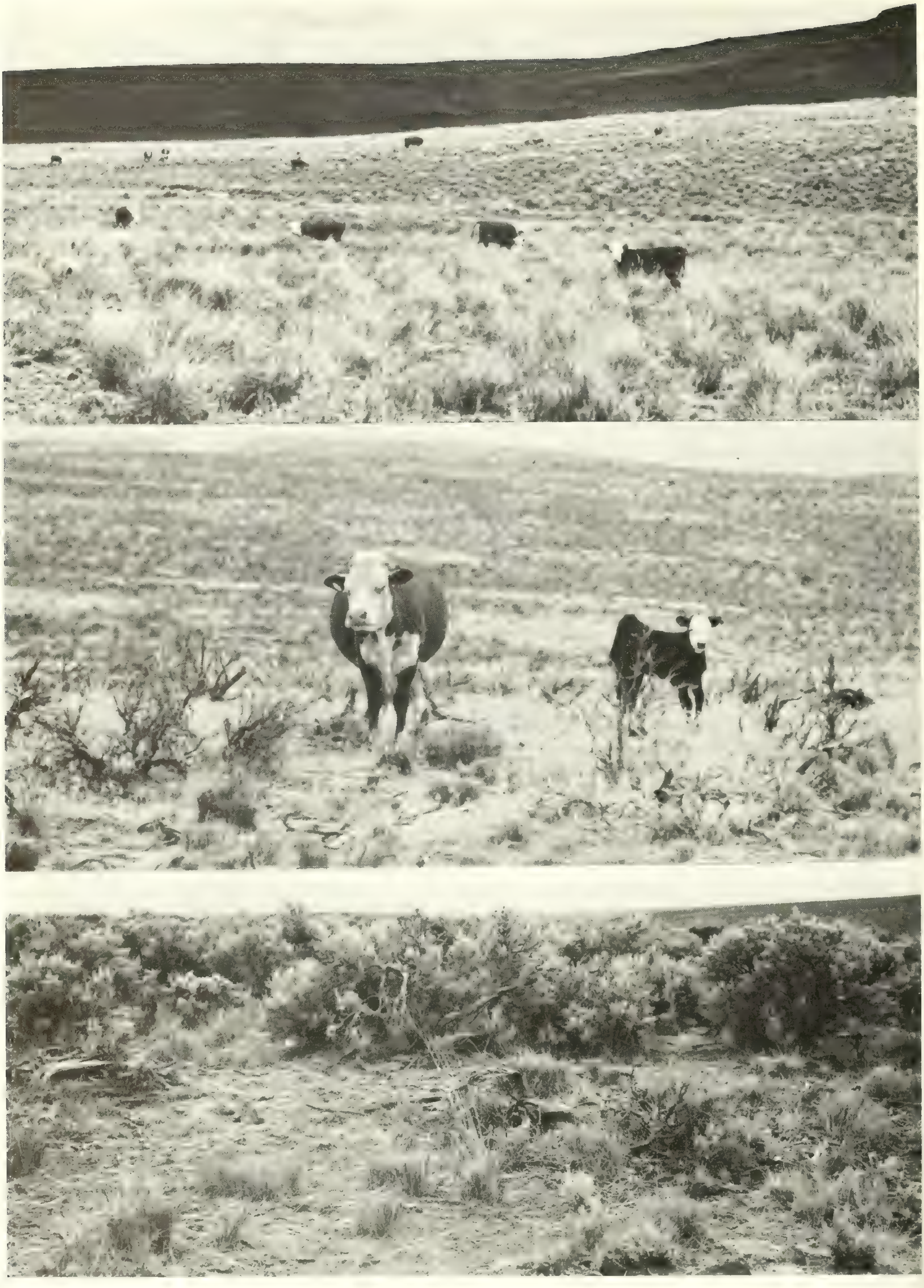


Figure 28.--Top, cattle entering a stand of bluebunch wheatgrass (big sagebrush reduced by spraying) about June 20. The middle photo shows proper use of bluebunch wheatgrass in June without big sagebrush, and bottom, with big sagebrush.

bunchgrass were effective practices. Many ranges are now in good to excellent condition and the permittees have learned to manage the vegetation as well as the livestock. Some of the seasonal plans could be improved. We see little need and some disadvantage in yearlong resting of pastures with good to excellent stands of bluebunch wheatgrass. The bunches accumulate dead material in their centers, causing increased fire hazard and less vigor in the plant.

Some grazing each year in the mature bunches promotes greater vigor than no grazing at all. Deferred and rotational treatments must be maintained. Season-long use should be included in some systems. This is the most flexible method of livestock use, involves a minimum disruption of livestock, takes less labor, reduces animal diseases related to crowding, and allows animals to exercise natural selectivity of forage. With proper regulation of animal distribution and numbers, season-long use of ranges in good to excellent condition can be a highly satisfactory grazing treatment. The time has arrived to take a new look at seasonal grazing systems on the basis that the ones needed for rehabilitation are not necessarily the best, especially not for using excellent condition range.

CONTROL OF ANIMAL DISTRIBUTION AND MANAGEMENT

Any effective modification of forage production must include provisions for control of animal numbers and distribution. Improvements such as fences, gates, roads, and water furnish the attractions and boundaries needed to control animal distribution.

Water controls animal distribution more than fencing but both could have been used more effectively in the Vale Program. A few pipelines terminate in troughs located near the bottoms of drainages, where livestock naturally congregate. Perhaps these locations were selected by compromise between engineering and managerial requirements. Not only must the systems function for entire grazing systems; they must be continually maintained, at a substantial cost. In 1975, maintenance of the district's water systems required 15 full-time employees. Maintenance of water has been critical for livestock survival. Minimized installation costs and engineering considerations led to high maintenance costs in a few instances.

Water, to the ranchers, was the first priority for development. Lack of water on large land tracts in the districts had prevented grazing abuse, and abundant forage was going unused. The ranchers argued that more drinking water would make use of that feed possible.

The BLM rightly resisted development of water without an overall plan which included the needs for protection and encouragement of wildlife as well as the use of all feasible range management practices. Livestock water also improves wildlife habitat, particularly around fenced reservoirs, and even provides new wildlife habitat. Where livestock are uncontrolled, water developments can be ineffective for wildlife. Overall, the water systems on the district operate with high efficiency as managerial devices.

Supplementary feeds other than minerals are not allowed on Vale District lands, and none are needed. Uneven use of salt and mineral supplements results in poorer than expected distributional control of livestock. Often salt blocks are dropped near water, along roads, and in other undesirable locations. Allotment management plans need to specify appropriate locations for placement of salt.

Ranchers, for the most part, practice herding of animals for animal husbandry requirements. Unfenced seedings that did not have protective boundaries and fire rehabilitation areas within large pastures required herding to prevent concentration of livestock. Riders have been cooperatively employed between the Advisory Board and BLM to keep animals out of such areas. Herding is an expensive and necessary measure for proper range management. Herding does not substitute for the lack of properly placed fences and watering points. Several allotment management plans specify that a rider be used to influence animal movement where natural drift does not achieve desired grazing use. Any system for the control of animal distribution must also allow for flexibility in order to accommodate animal husbandry requirements.

MONITORING OF GRAZING

A management plan, no matter how sophisticated, cannot function properly for long periods without continual checks for compliance. BLM grazing policies and allotment management plans require monitoring even with stated acceptance by the user. Plans or policies may not be followed automatically, especially where memories of historic conflicts still exist.

Monitoring of livestock numbers and movement of animals from one pasture to another are a time-consuming but necessary part of the BLM managerial role. Thinly available manpower requires that most of the control rest with the users. Several management plans require that the user (1) limit livestock numbers and season of use to those specified in the written plan, and (2) submit certification of actual use at the close of the season. Ideally, this should be the method on all allotments as it fosters user responsibility.

Table 14 lists the number of formal trespass actions by year between 1961 and 1976. No trespass at all existed prior to 1934; the public range was free to all. Lack of data from 1934 to 1961 prevents evaluation of trespassing during that period. The increase in number of court cases to a maximum in 1966 resulted from increased surveillance. Afterwards, compliance with stocking rate restrictions improved and the cases declined.

Table 14--*Number of livestock trespass cases in the Vale District, Bureau of Land Management, by fiscal year*

Year	Trespassing cases	Year	Trespassing cases
1961	35	1969	32
1962	41	1970	24
1963	47	1971	18
1964	47	1972	8
1965	66	1973	16
1966	81	1974	5
1967	38	1975	18
1968	42	1976	32

Proof in animal trespass requires two witnessed observations and counts of the same animals at different times. Even so, trespass is extremely difficult to prove in common use allotments where ownership of animals can change. In a sample of 22 cases, each involved an average of 75 cattle or 13 horses and only one action implicated more than 135 head.

To ease administration of the monitoring program, the BLM started an ear-tagging procedure in 1975. Tags were issued for only the permitted number of animals. Licensees objected because of the added cost of labor to the tags.

Monitoring of grazing systems enforces regulations on animal movements between pastures and the length of time animals spend in the various pastures. Typically, BLM personnel observe compliance with animal movement dates by checking opening and closing of gates. A small number of trespass cases were due to grazing on areas which should have been either deferred or rested. Our observations during the course of field studies and the data in table 14 suggest that compliance was good over the district as a whole. Noncompliance was more likely to be caused by difficulty in gathering every animal from rugged terrain rather than from deliberate noncompliance with grazing schedules.

Small but important enclosed areas on the Vale District were built for scientific studies, plot tests, protection of riparian vegetation, protection of reservoirs, and for wildlife habitat. Evidence of trespass animals was occasionally observed in these enclosures. Although the probable impact on the vegetation was not great. The high and specific values of these enclosures make any grazing in them intolerable.

Vegetational Condition in 1975

METHODS

The methods of vegetational sampling used in this study provide information on the results of the Vale Program, and they also suggest a need for more efficient and accurate sampling of range vegetation than has been accomplished in the past by the district. The parameters measured were density of selected species and percentage of botanical composition by foliage cover. Time restraints limited the sampling methods to those which yielded data rapidly. Large representative sections within each project area and in adjacent untreated brushland were selected as the general locations of the samples. Of the 164 projects listed in table 6, 153 were sampled. Many rehabilitation projects resulted in relatively uniform vegetation with adjacent untreated brush stands relatively homogeneous in density and cover. Therefore, a single or a few large samples were taken in each project, placing the emphasis on variable results among projects rather than within them.

Major species in paced belt transects, each 18 inches wide and 200 yards long (46 cm by 183 cm), were tallied to obtain densities. A hand carried T-shaped sampling fork established the transect width. Plants with more than 50 percent of their base within the belt were tallied on hand counters. Infrequent species were tallied directly. Only major categories of brush and desirable grasses were included in this type of sample. The recorded grasses included as desirable were crested wheatgrass, bluebunch wheatgrass, basin wildrye, Idaho fescue, Thurber's needlegrass, and Indian ricegrass but not Sandberg bluegrass, squirreltail, and cheatgrass. Coefficient of variation among transects was about 50 percent.

After completion of the transects, the surveyor estimated botanical composition on a basis of foliage cover. His notations at each site included the presence of seedlings, dead plants, erosion, grazing use, and other characteristics. Many sites were photographed. Thus, counts and reconnaissance evaluations provided the data for vegetational analysis.

In June of 1976, 50 sagebrush plants were collected in each of six project areas to determine age through ring counts, density on the ground, and size of plants.

UNTREATED AREAS

Sampling of adjacent treated and untreated areas provided data for comparisons and evaluations of projects. Results from the untreated areas do not apply to the Vale District as a whole but only to those sites which have undergone brush control, seeding, and fire. Projects were concentrated in the big sagebrush-grass vegetational type so all untreated samples came from that one type.

Overall vegetational composition of untreated rangeland is related to elevation and rainfall. Since these two factors correlate on the Vale District, rainfall will serve as the basis for comparison. Samples from 65 untreated sites were divided into 4 rainfall categories, 6-8, 8-10, 10-12, and 12-14 inches (152-203, 203-254, 254-305, 305-357 mm) of annual precipitation with 5, 27, 28, and 5 samples per category, respectively.

Brush density averaged 1.05 plants/yd^2 (1.25 plants/m^2) (fig. 29). Big sagebrush remained consistent and rabbitbrush increased in density with increased rainfall. Lack of significant correlation between brush density and desirable grass density fails to show a consistent relationship. This suggests that the density of brush does not determine density of grass, but instead, that the grass is related to rainfall (fig. 30).

Density of desirable grasses was greater at higher rainfall (and elevation) than at lower rainfalls (fig. 29). In areas with annual rainfall of less than 8 inches (203 mm), the desirable grasses were almost entirely bluebunch wheatgrass. At 8-10 inches (203-254 mm), bluebunch wheatgrass still dominated but the stand included basin wildrye on low lying areas. Idaho fescue and needlegrass were present in significant numbers above 12 inches (305 mm) of rainfall. Bluebunch wheatgrass was the most common desirable grass at all rainfall categories.

When related to precipitation, brush species showed the same trends in relative percent species composition as they did in density; big sagebrush remained constant at 50 percent of the stand, and rabbitbrush became more important as rainfall increased (fig. 31). Rabbit brush formed less than 1 percent of the vegetation in areas with rainfall of less than 10 inches (254 mm), and about 5 percent with more than 10 inches (254 mm). Bitterbrush, present in areas with more than 12 inches (305 mm) of precipitation, never exceeded 1 percent of the cover. Relative percent of brush cover declined with increased precipitation.

Desirable grasses, when analyzed, revealed the same trends for relative cover as they did for density (fig. 32). Cheatgrass decreased in importance as rainfall increased, squirreltail followed the same trend as bluebunch wheatgrass, and Sandberg bluegrass reached its greatest percentage of the stand at middle amounts of rainfall. Annual forbs in the season sampled averaged 1 percent or less of the cover for all rainfall groups.

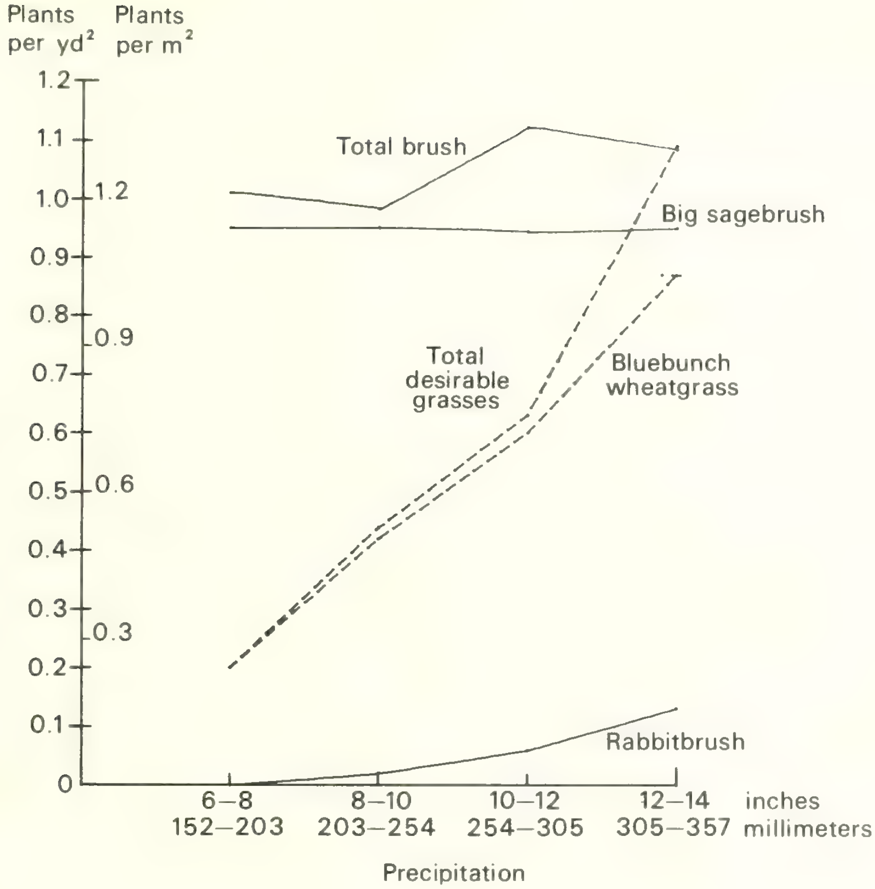


Figure 29.--Density of brush and grasses on 65 untreated areas in 1975 in relation to mean annual precipitation.

Estimates of percentage species composition provided a basis for comparison with step-point data taken prior to treatment in the 1963-68 period. Interpretation of the differences directly pertains to plant succession and range trend. Plant groups compared include big sagebrush, rabbitbrush, bitterbrush, total brush, bluebunch wheatgrass, desirable grasses, squirreltail, Sandberg bluegrass, cheatgrass, and annual forbs. Interpretations must be evaluated in the context that different sampling methods were used. Seasonal and yearly variability also undoubtedly contributed to the differences, especially where cheatgrass and annual forbs formed a significant part of the vegetative cover (fig. 33).

Samples in the years 1963 to 1968 contained more cheatgrass and annual forbs than those in 1975. This may be either improvement in the range condition or yearly variability. On the other hand, the increased percentage of brush and desirable grass in 1975 may indicate a real decrease in percentage of annual grasses and forbs. Changes in composition within the group of perennial grasses,

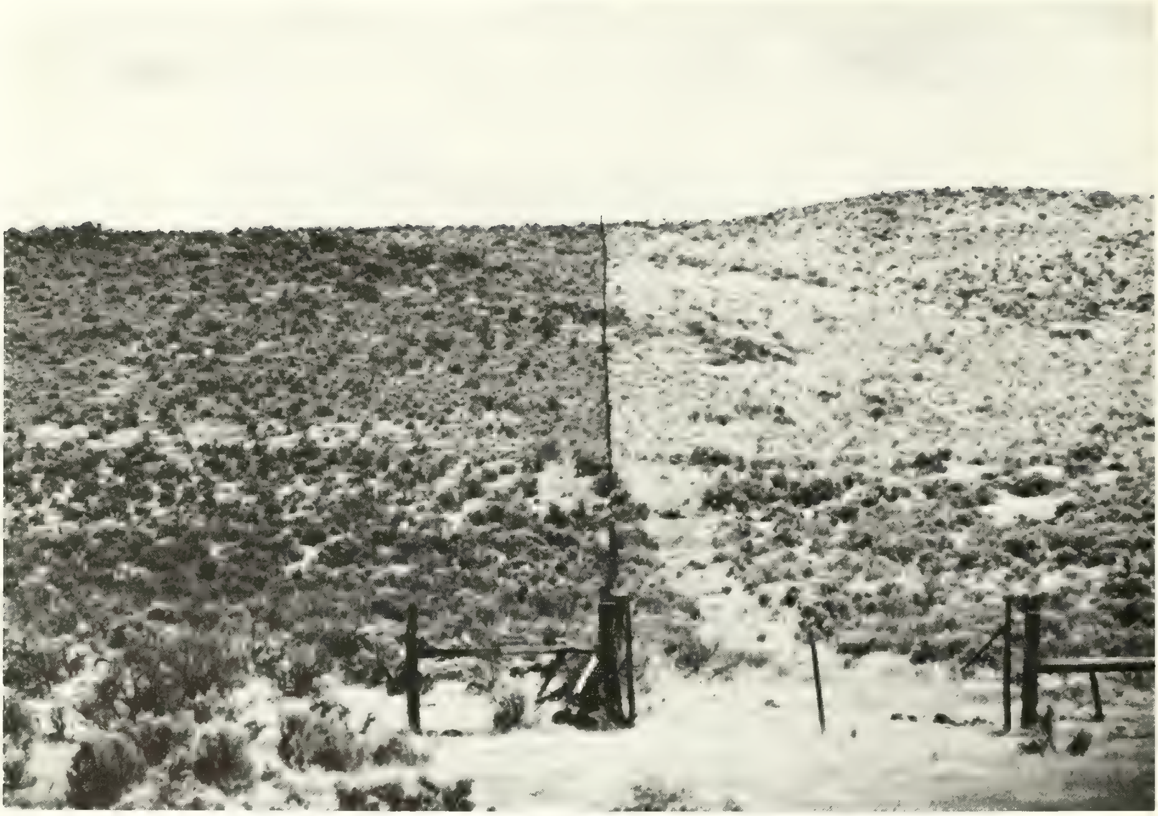


Figure 30.--Neither the monoculture of the big sagebrush on the left nor the sagebrush-bluebunch wheatgrass mixture on the right received a brush control treatment. The differences in botanical composition are due to livestock management.

28 percent of the vegetation, suggest that range improvement has occurred. The small increase from 8.5 percent desirable grasses in 1963-68 to 11.1 percent in 1975 masks important changes (fig. 34). Bluebunch wheatgrass increased from 8.1 to 10.2 percent and squirreltail from 3.5 to 6.9 percent, whereas Sandberg bluegra decreased from 16.1 to 9.7 percent.

These modest changes in percentages portray significant ecological effects. The taller grasses now occupy more space between the sagebrush plants than they did in 1963-68, hence there is less room for Sandberg bluegrass and cheatgrass. These results substantiate the description given earlier for the climax vegetation and, in fact, contribute to that description.

An additional point needs emphasis. Little ongoing increase in the density of bluebunch wheatgrass was actually observed. Sampling disclosed few seedlings of this species. Perhaps none were needed to maintain many of the stands because the bluebunch wheatgrass plants on grazed untreated areas were growing vigorously with no dead plants and few dead centers of plants. The only plants of bluebunch wheatgrass in poor condition individually in relation to livestock grazing were some of those in an exclosure west of Jordan Valley which had *not* been grazed by livestock for several years. Resting an area for a year or more without grazi

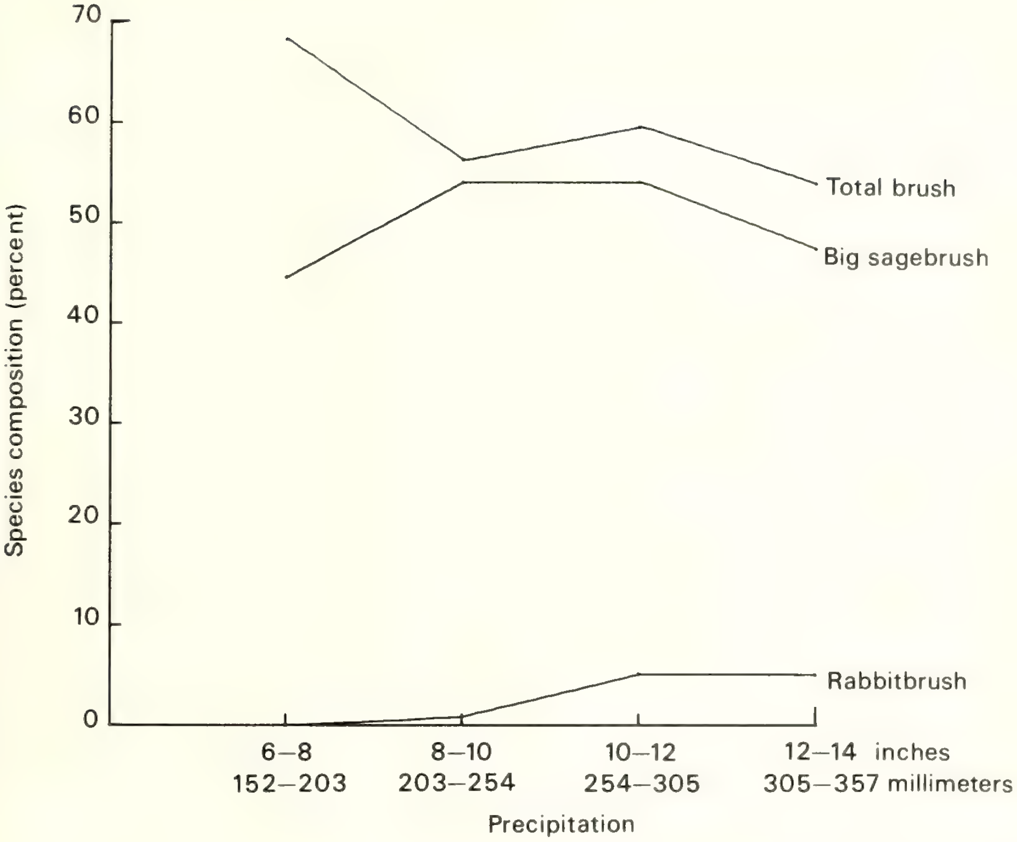


Figure 31.--Composition of brush on untreated areas in 1975 in relation to average annual precipitation.

promotes accumulation of litter and dying in the centers of bluebunch wheatgrass. Many areas without brush control are in much improved range condition in 1975 over what they were in the early 1960's. Several allotments in the northern part of the district, however, will take decades to improve significantly because of the virtual absence of desirable grasses.

Methods previously used by BLM personnel for evaluating range condition on the Vale District were inadequate for our purposes. A few key sites were selected for permanent plots, each consisting of a photo point and a staked yard-square (0.836 m^2) plot on which vegetation was mapped. Proper evaluation of an entire management unit could not be made from examination of one to a half dozen of these small plots. Photos yielded valuable information and should be continued. Mapping of the small plots, however, is time consuming and of questionable accuracy because of infrequent sampling by a wide spectrum of individuals, some with little interest in the assignment, and none with adequate instruction. A more reliable method for collecting adequate condition and trend data should be found. A second fault with the present plots is that most were located close to water and other places of livestock concentration, hence they do not represent entire management units. A third problem with these plots stems from the practice of including cheatgrass

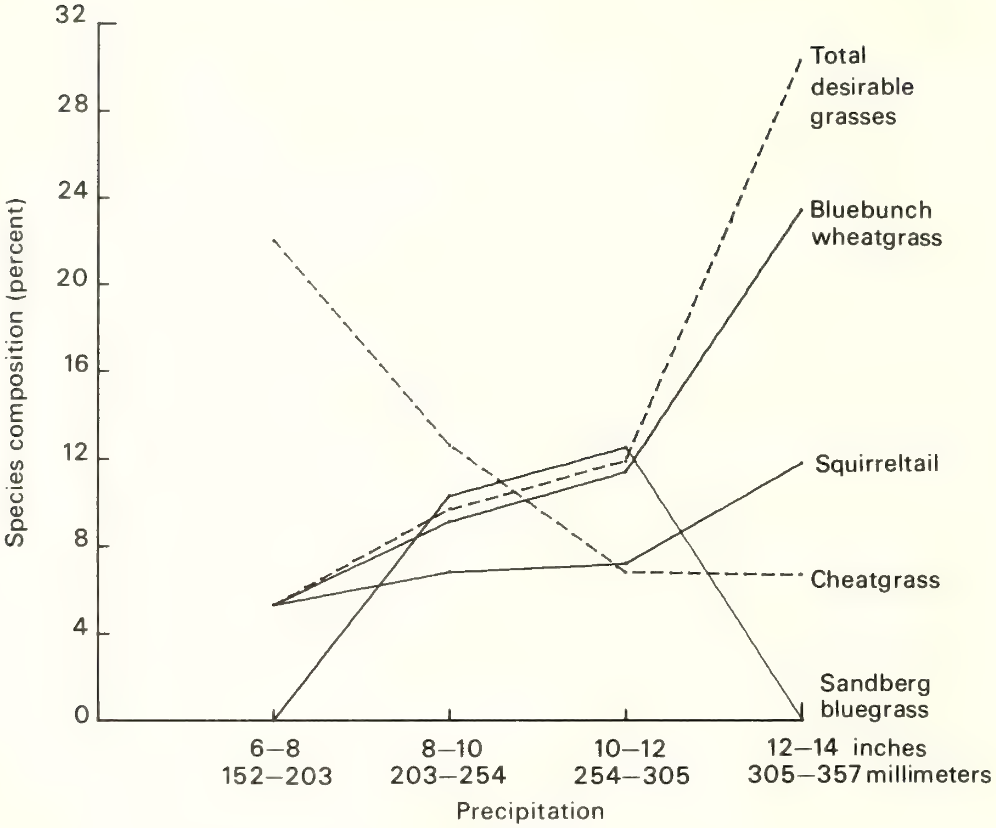


Figure 32.--Relative percentage species composition of grasses on untreated areas in 1975 in relation to average annual precipitation.

in the trend sample, thus confusing high yearly variability in cheatgrass stands with long-term trends in range condition. Annuals should be included in the analysis as important parts of the vegetation, but their small and ephemeral nature makes them difficult to map and the maps of doubtful meaning. A fourth problem is inadequate plot size. A yard-square plot included less than one big sagebrush plant and about three of the desirable perennial bunchgrasses on the average. A large number of these plots would be needed on each site in order to obtain an accurate estimate of range condition and trend.

New procedures need to be established for monitoring changes in vegetation on the lands administered by BLM. The technique should apply to large managerial units, give reasonably pertinent and accurate data on vegetational changes, and be useful to nonresearch-oriented personnel, who have many other assignments.

BRUSH CONTROL AND SEEDING TREATMENTS

Seedings followed four pretreatment practices: plowing, spraying, wildfire, and no preparation prior to planting. A few reseedings followed unsuccessful

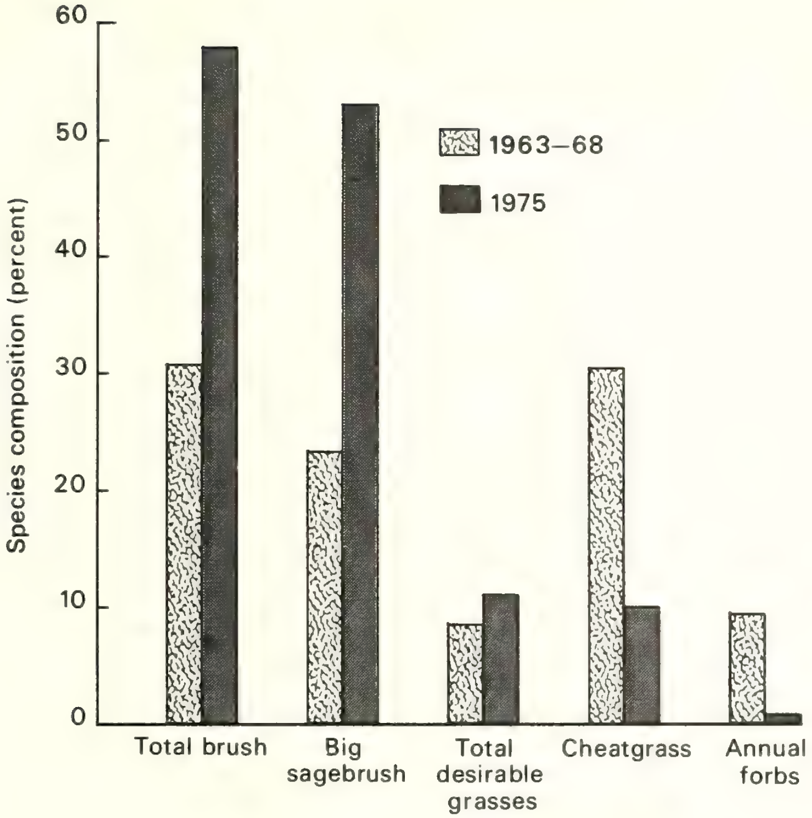


Figure 33.--Species composition, 1963-68 and 1975.

prior attempts--as many as three or four tries. This section of the report examines the vegetation that returned following brush control and seeding. All seedings were to crested wheatgrass, unless stated otherwise.

In general, similar big sagebrush kills were obtained with either spraying-and-seeding or plowing-and-seeding. Many well-executed and planned operations resulted in kills exceeding 95 percent (figs. 35 and 36). The relationship between sagebrush kill and longevity of projects, however, is not at all clear. Brush density on untreated areas averaged 1.05 plants/yd^2 (1.25/m^2), 0.95 (1.14) big sagebrush, 0.04 (0.05) rabbitbrush, and 0.06 plant/yd^2 (0.07/m^2) of other species (fig. 37). Big sagebrush was dramatically killed by all treatments, with wildfire the most effective in reducing its density. Burned areas averaged only 0.09 big sagebrush plant/yd^2 (1.08/m^2). Areas sprayed and seeded showed the lowest sagebrush density of any nonburned section with 0.17 plant/yd^2 (0.20/m^2). Plowing reduced big sagebrush density to 0.24/yd^2 (0.29/m^2); spraying alone was least effective with 0.26 plant/yd^2 (0.31/m^2) (fig. 38). Lowest sagebrush densities were observed where seeding followed spraying, rather than with no seeding.

Rabbitbrush was more common on treated areas than untreated, averaging 0.04/yd^2 (0.05/m^2). Plowing effectively reduced rabbitbrush to 0.02/yd^2 (0.024/m^2). Spraying resulted in higher density, 0.05 and 0.08/yd^2 (0.06 and 0.09/m^2) for

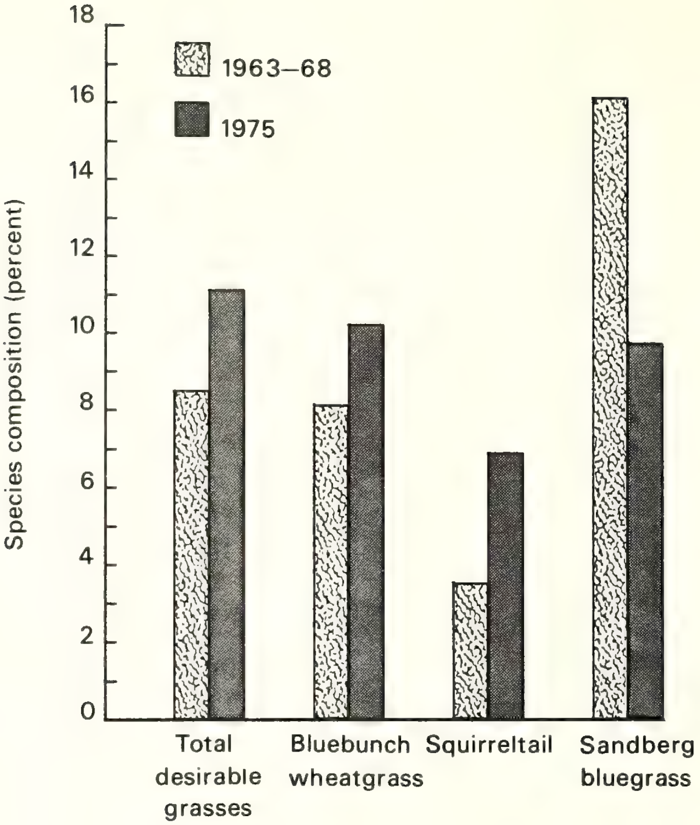


Figure 34.--Percentage species composition of perennial grasses, 1963-68 and 1975.

for seeded and nonseeded sprayed areas. Rabbitbrush was strongly correlated with particular soil and elevational types, complicating interpretation of the results.

Brush control projects which were without seedings used aerial application of 2,4-D to kill big sagebrush. This practice was used most often.

Spraying had variable results. Sprays before 1965 used diesel oil as a carrier for the active agent, and they more effectively killed brush than the water-based sprays used beginning in 1965. Applications were timed more accurately by 1967, making the water-based sprays as effective as the earlier results with diesel oil (fig. 38). In paired treated and untreated samples, the untreated areas adjacent to sprays averaged 0.98 big sagebrush plant/yd^2 (1.17/m^2), and spray-treated samples averaged 0.26 plant/yd^2 (0.31/m^2) (fig. 39), half of which became established after treatment (see next section). Estimated initial overall percentage kill by spraying was 80-90 percent.

Desirable grass density increased in unseeded sprayed areas. Paired treated and untreated adjacent transects had 1.02 desirable grasses/yd^2 (1.22/m^2) on treated areas versus 0.81/yd^2 (0.97/m^2) on untreated areas, a 25-percent increase in grass density due to spray treatment.

When crested wheatgrass is grouped into four categories of areas with 6-8, 8-10, 10-12, and 12-14 inches (152-203, 203-254, 254-305, 305-357 mm) of average precipitation, little difference is noted between success at the various rainfall

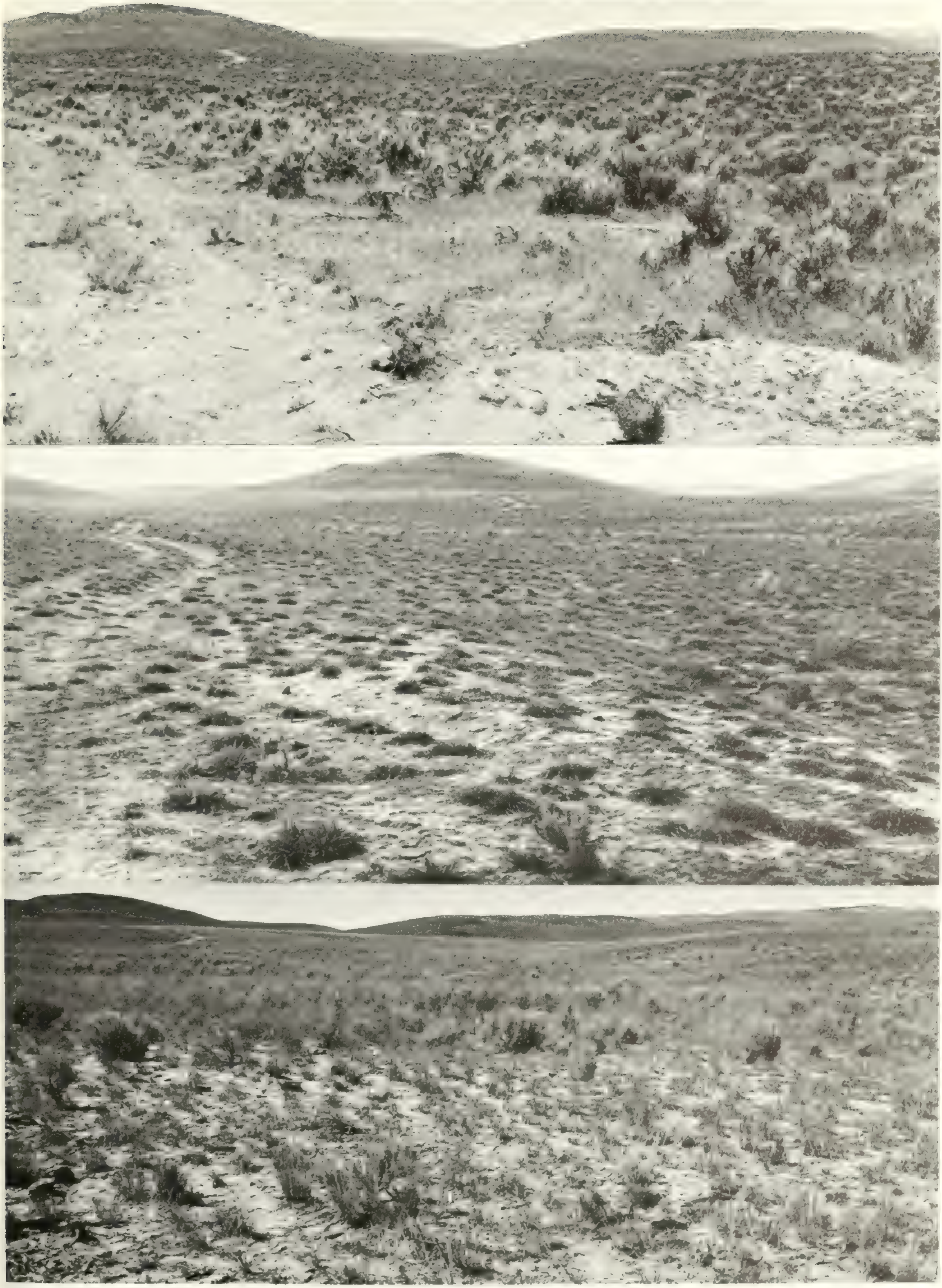
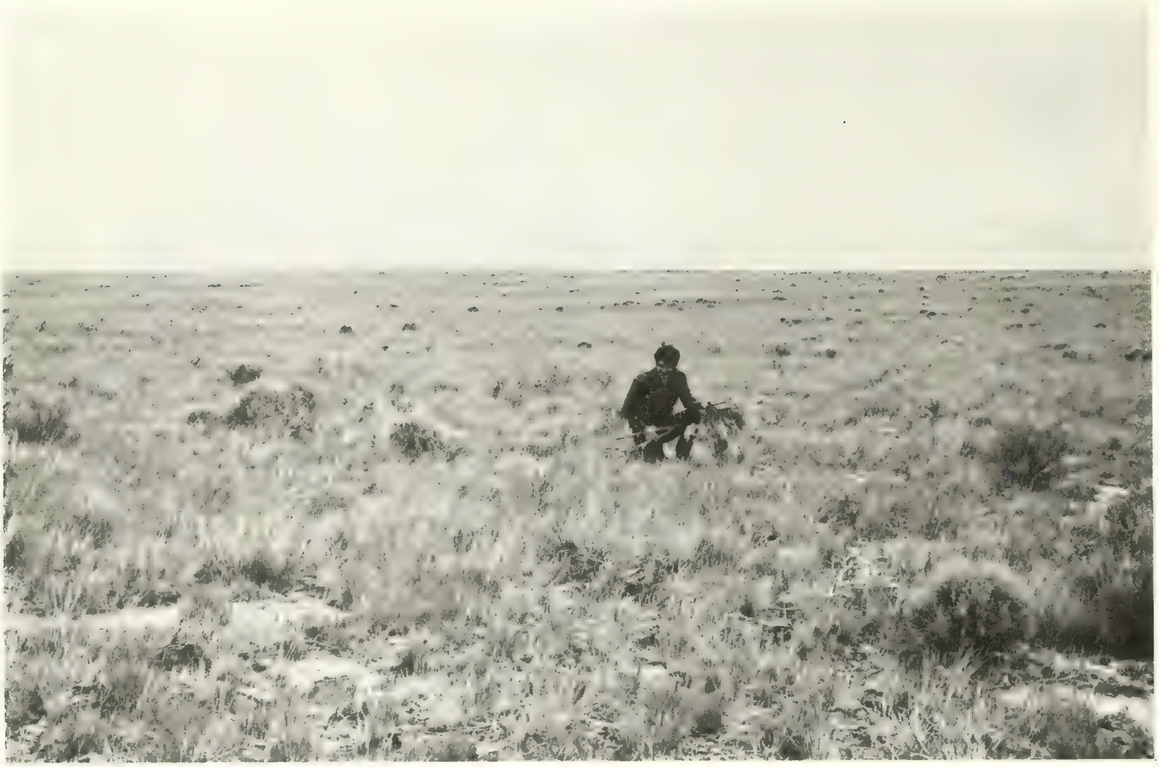


Figure 35.--Top, N. G. Creek seeding site dominated by big sagebrush and cheatgrass before treatment in 1963 (Bureau of Land Management photo). Middle, grazed crested wheatgrass with little apparent big sagebrush in 1969 (Bureau of Land Management photo). Bottom, big sagebrush appears as a scattered stand in 1975.



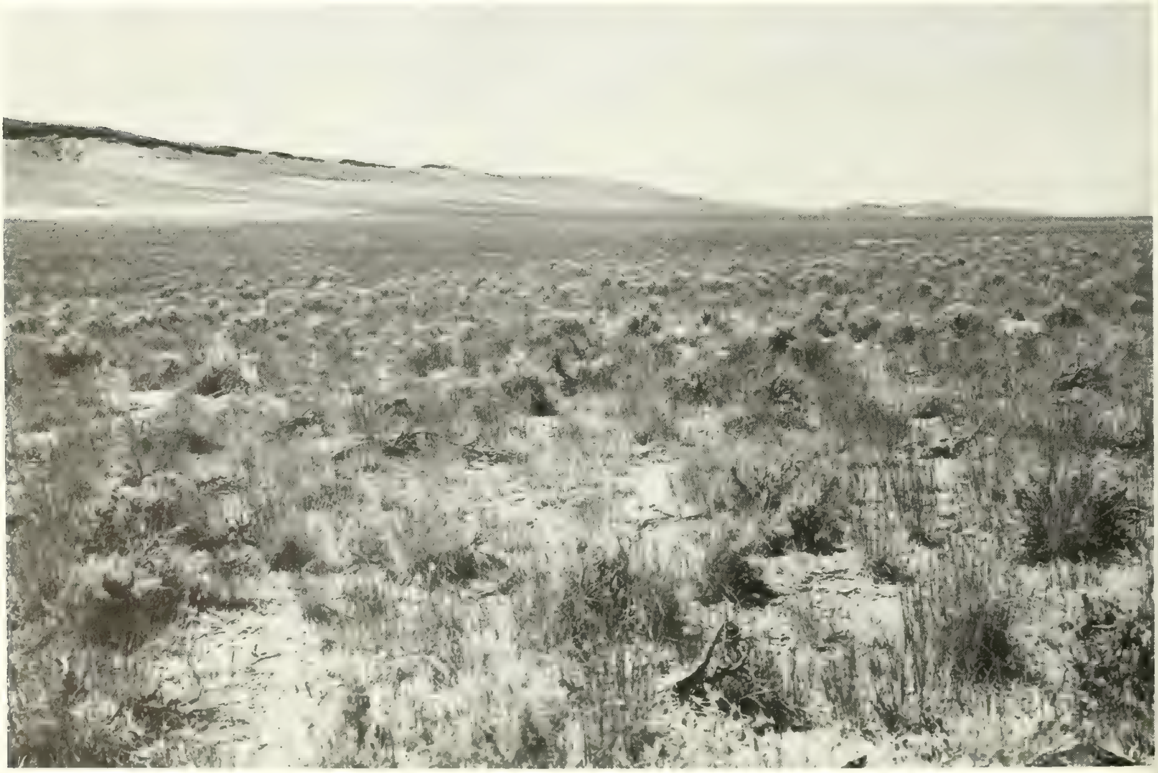


Figure 36.--The spray-only treatment (top) released bluebunch wheatgrass which developed into a thick stand. Most spray and seed treatments also developed grasslands (bottom). Big sagebrush invaded areas receiving either treatment.

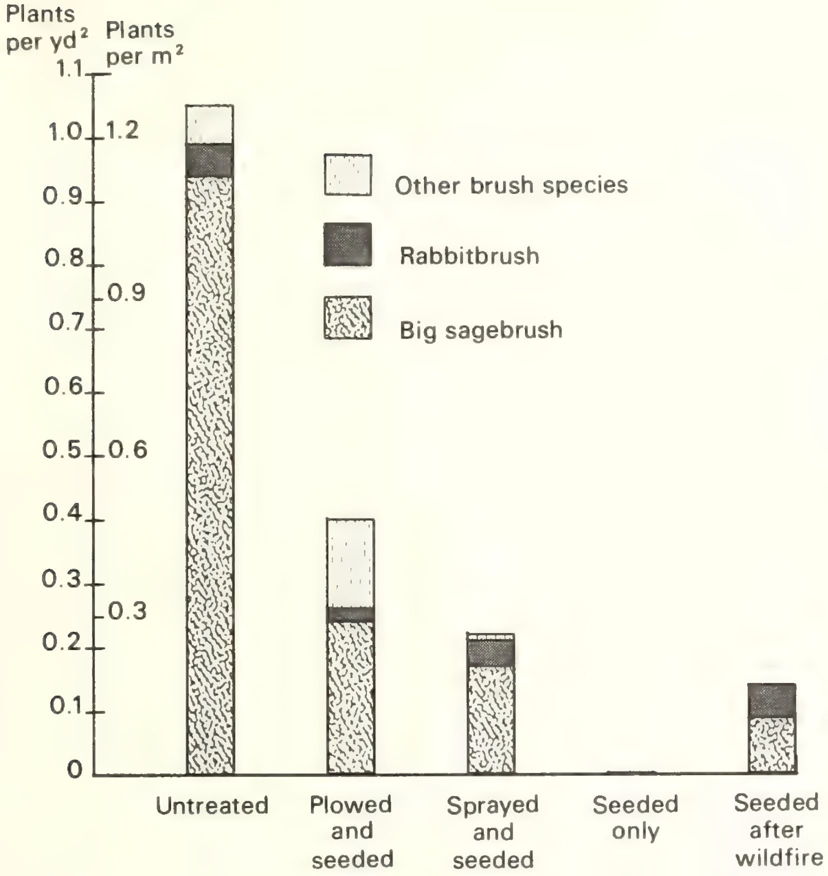


Figure 37.--Density of brush in 1975 in seeded areas, by treatment.

levels. Plow-and-seed operations resulted in crested wheatgrass densities of 3.19, 3.11, and 3.38 plants/yd^2 (3.82, 3.72, and 4.04/m^2) for the three lowest levels of rainfall. However, the dry years reduced seedling success. The 2 years with the least rainfall during the Vale Project, 1966 and 1968, resulted in poor seeding success with average densities of 2.82 and 2.11 plants/yd^2 (3.37 and 2.52/m^2) for plow-and-seed and spray-and-seed operations compared with the overall average success of 3.15 plants/yd^2 (3.77/m^2). Generally, plowing was the most successful preseeding treatment, giving an average crested wheatgrass density of 3.22 plants/yd^2 (3.85/m^2) (fig. 40). Spraying, fire rehabilitation, and no pretreatment, in that order, resulted in 2.99, 2.77, and 2.17 plants/yd^2 (3.58, 3.31, and 2.60/m^2). The two sampled attempts at reseeding without site preparation following initial failure were judged unsuccessful with only an average of 1.61 perennial grass plants/yd^2 (1.93/m^2).

Percentage compositions of species on seeded areas generally parallel these for density. Plow-and-spray reduced brush composition of 59 percent for untreated areas to 12 percent, and burning lowered the composition to 9 percent. Notable, however, was that the highest average percentage composition of desirable grasses

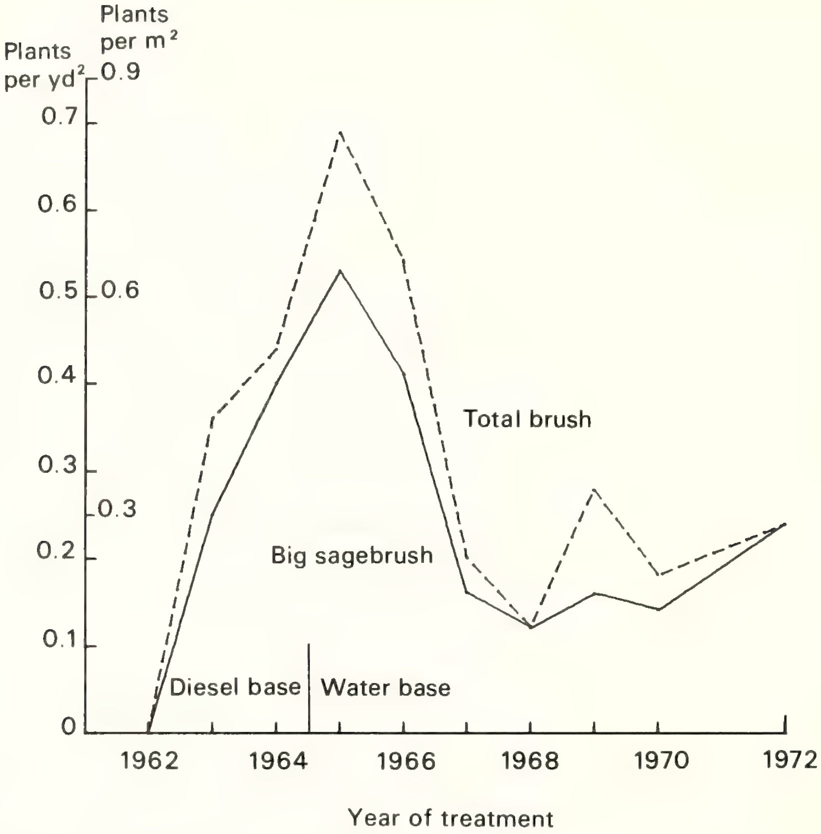


Figure 38.--Density of brush in 1975, averaged for the year of spray treatment with 2,4-D at 2 lb acid equivalent per acre (2.2 kg/ha).

occurred on spray-and-seed areas. The slightly lower percentage composition of crested wheatgrass in sprayed areas compared with plowed areas (49 vs. 55 percent) was balanced by the presence of desirable native grasses in the sprayed areas. Although sprayed-and-seeded areas were among the poorest ranges on the Vale District at the beginning, the presence of remnant native grasses resulted in an average of 60-percent desirable grasses (11-percent native and 49-percent crested wheatgrass). Spraying, by not killing native grasses, resulted in significantly better mixtures of perennial grasses than plow-and-seed.

Trend in grass composition on treated areas was closely related to the rate of change in the brush population, not to changes in their own density. Since the grasses displayed little evidence of decrease or change in density, downward trend would be the result of brush reinvasion. A widely accepted proposition in many evaluations of range improvement by means of brush control stipulates that the improvement has a finite lifespan due to return of brush. We disagree with this proposition in the Vale District. Few areas on the district which were successfully treated will require retreatment to maintain a substantial portion of their forage productivity. Brush will invade but not to the degree that grasses will be greatly impaired--as long as overgrazing does not destroy the grasses.

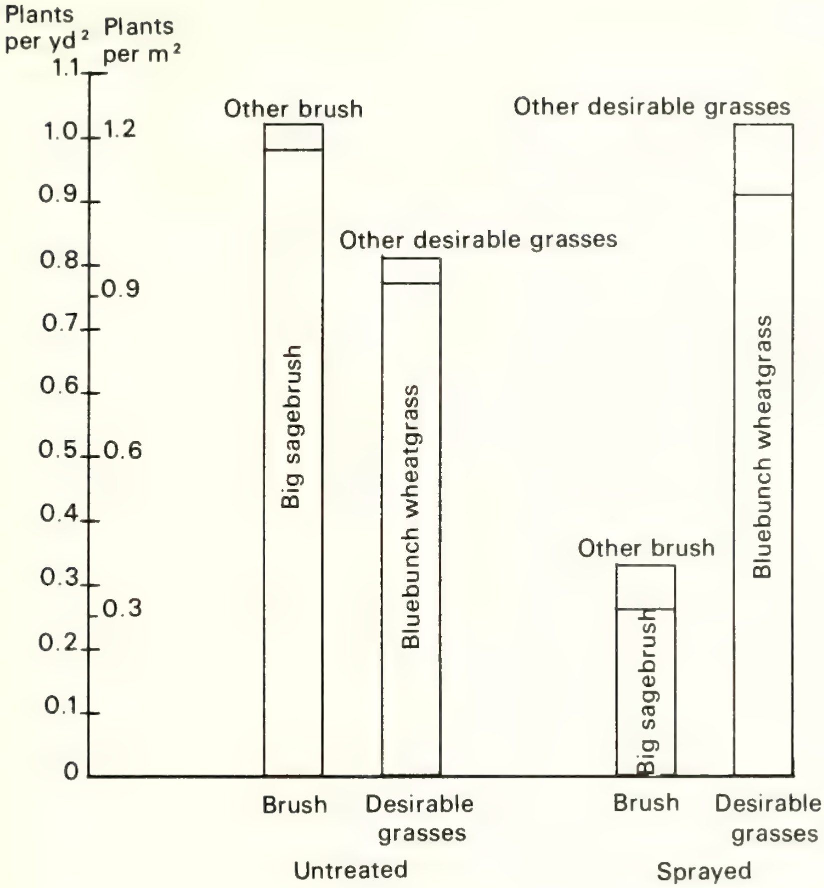


Figure 39.--Comparison of sprayed areas and adjacent untreated areas, 1975.

BIG SAGEBRUSH REINVASION

To further investigate the structure of controlled sagebrush and seeded stands, we obtained 300 plants of big sagebrush in lots of 50 from six project sites (table 15). All big sagebrush plants within a 1-meter-wide belt were measured for crown diameter and height and were cut at ground level for ring counts to estimate age. The sample ended when 50 plants had been measured. Although rotten centers and incomplete rings reduced the accuracy of age determination, the number of annual rings in any stem younger than approximately 20 years gave a good estimate of the age of the plant. Estimates of actual age were not possible in 29 plants, or about 10 percent of the samples, because of missing centers.

Areas sampled were chosen primarily for convenience and thus do not constitute a representative sample of the Vale District as a whole. However, the data point to important facts concerning treatments, their effectiveness, and sagebrush reinvasion in general.

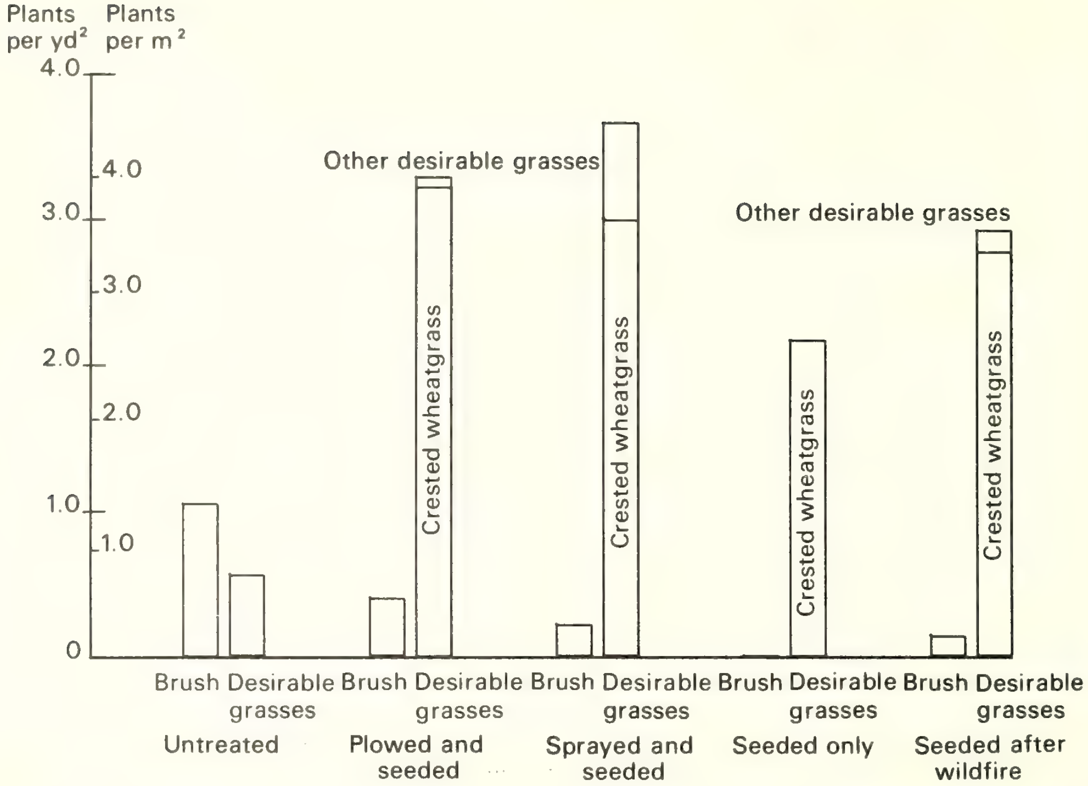


Figure 40.--Density of brush, crested wheatgrass, and other desirable grasses in 1975 according to treatment before seeding.

Table 15--*Age in years and density of big sagebrush on six treated areas, Vale District, Bureau of Land Management, 1976*

Project name	Number of project	Age at time of treatment	Age				Plants per square yard[1]
			Mean	Median	Min.	Max.	
		- - - - - - - - - - Years	- - - - - - - - - -				
Ten Mile seeding	1	24	17.7	19	5	24	0.35 (.42)
Brickey Springs seeding	8	15	12.6	13	6	21	.24 (.29)
Rock Creek seeding	15	14	12.2	12	5	26+	.63 (.75)
Big Ridge seeding	106	9	9.3	9	1	18	.24 (.39)
Antelope seeding	109	9	11.2	10	7	23	.33 (.39)
Basque seeding	111	9	15.4	11	3	38+	.54 (.65)

[1] Figures in parentheses are plants per square meter.

Size of plant and age were poorly correlated (fig. 41). The best regression coefficient for age on size of plant was obtained in the Basque brush control but it was only r = 0.482. The Big Ridge, Antelope, and Rock Creek seedings all had correlations of less than 0.13 or no relation at all between size and age. The practice of making inferences about age-class distribution of sagebrush stands based on size classes is highly inaccurate and in fact may lead to erroneous conclusions. Often, apparent seedlings less than 5 inches (1 dm) tall may be more than 10 years old. As an example, the Big Ridge seeding yielded sagebrush plants within a few meters of each other, both with nine growth rings, one with a crown 2.5 by 1.5 inches (6 by 4 cm) and the larger 32 by 36 inches (80 by 90 cm). Brickey Springs had two adjacent plants, one with 14 rings and 8 by 4 inches (2 by 1 dm) in size; the other 15 rings and 36 by 50 inches (9 by 12.5 dm) in size.

A common assertion is that big sagebrush invades rapidly following land treatment and that most seedlings become established at that time. In general, the results of the age-class survey substantiate that claim. On three of the treated areas the most numerous age class occurred the year after the treatment. This effect was particularly pronounced in the Big Ridge seeding where 32 of the 50 plants in the sample apparently established in the 2 years following treatment in 1966 (fig. 42). All treated areas showed evidence of continued establishment in the years following treatment except that the Antelope and Brickey Springs seedings had no plants younger than 6 years (figs. 43 and 44).

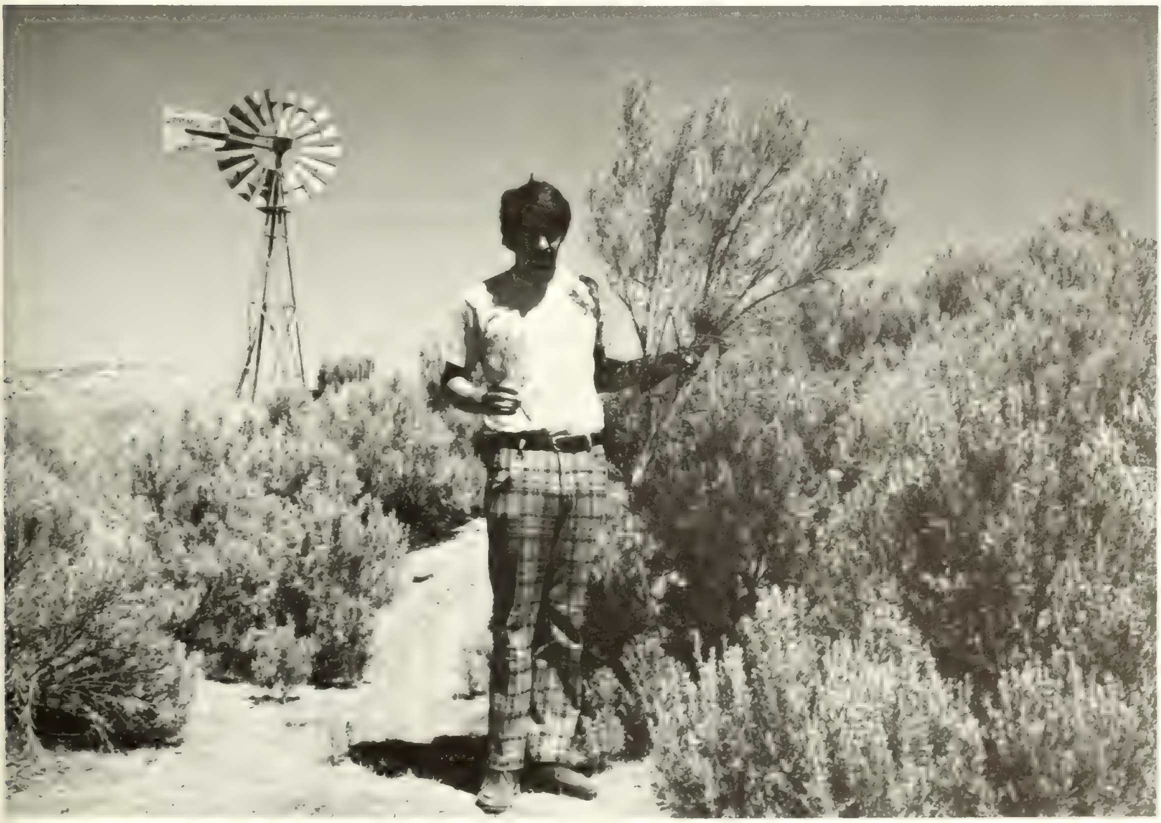


Figure 41.--Both these plants of big sagebrush, growing side by side, were 9 years old.

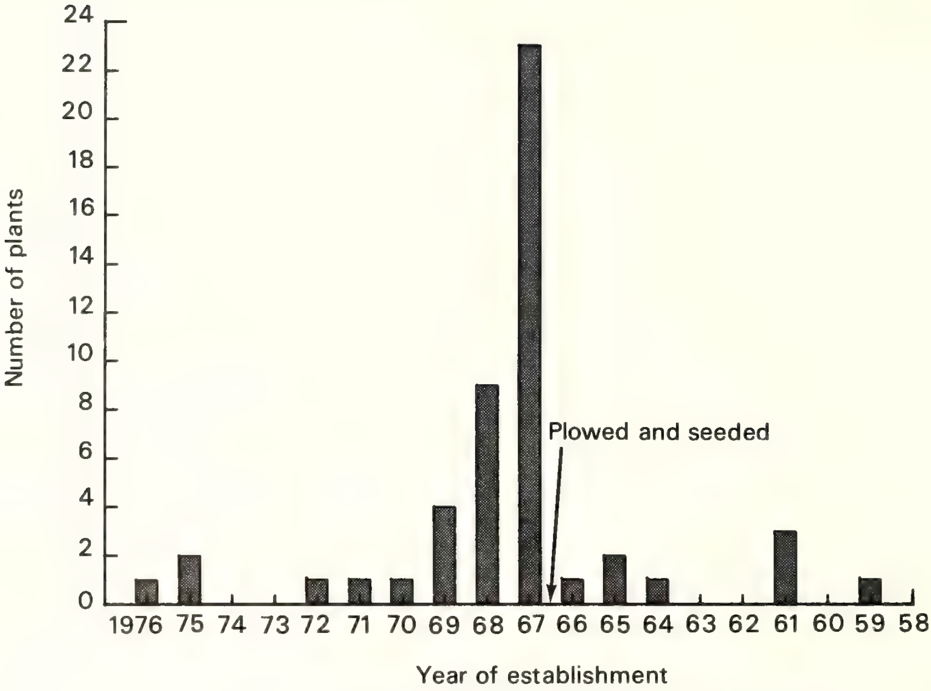


Figure 42.--Age-class distribution of big sagebrush, Big Ridge seeding project.

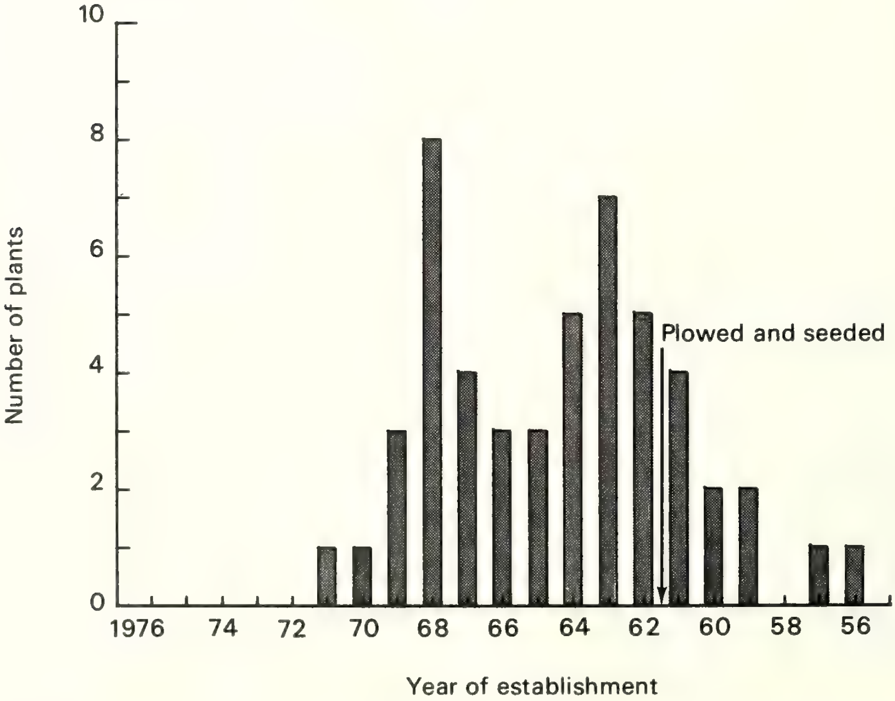


Figure 43.--Age-class distribution of big sagebrush, Brickey Springs seeding project.

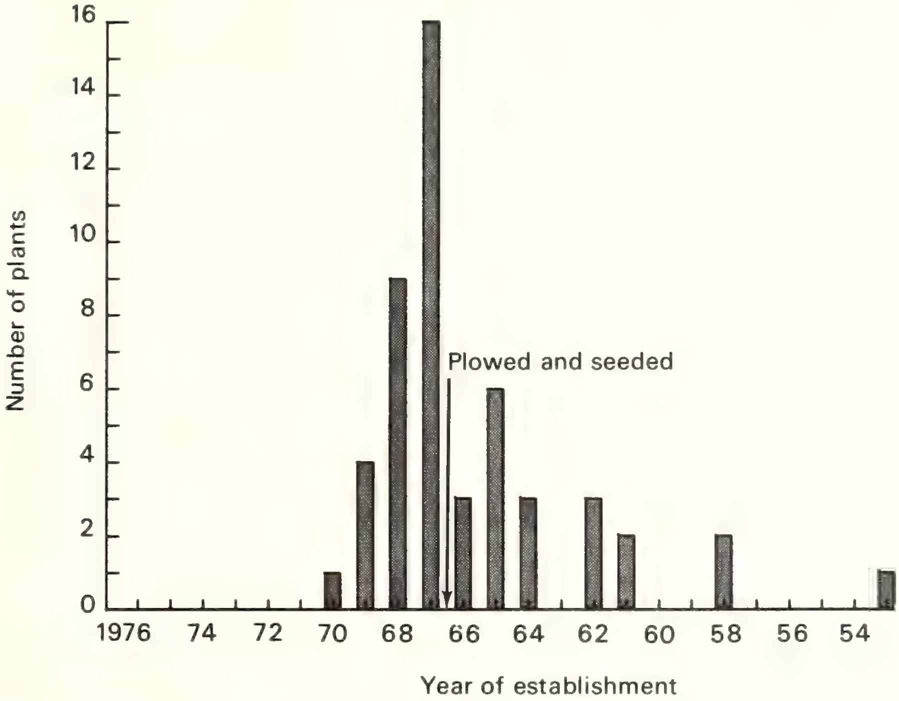


Figure 44.--Age-class distribution of big sagebrush, Antelope seeding project.

The Brickey Springs seeding had large and obvious big sagebrush, whereas the Antelope seeding appeared relatively free of big sagebrush plants because they were small (fig. 45). Densities of big sagebrush plants in the two areas were similar. Big sagebrush crown cover in Brickey Springs was 5.7 percent, but only 1.6 percent in Antelope; yet median ages were similar--13 years in Brickey Springs and 10 years in Antelope. The only real difference was that the big sagebrush plants in Brickey Springs were larger and hence covered more area.

Only the Ten Mile seedings displayed complete kill of big sagebrush by initial treatment (fig. 46)--no plants older than the treatment were found. In all other projects sampled, ample big sagebrush plants remained after treatment to allow reinvasion from seed produced. Invasion is by establishment of seedings immediately after treatment from seed on the site and from seed produced later. Little evidence was found that particular years were more favorable for sagebrush establishment than others. Individual areas showed groups or cohorts of seedlings, but they were of different ages. From 1970 on seems to have been unfavorable for sagebrush establishment.

This sample, encompassing many years of treatment, resulted in some conclusions concerning the life expectancy of crested wheatgrass seedings and the rate of big sagebrush reinvasion. First, older brush controls did not show more sagebrush invasion than younger projects. Degree of big sagebrush invasion related to the type and effectiveness of the particular treatment rather than

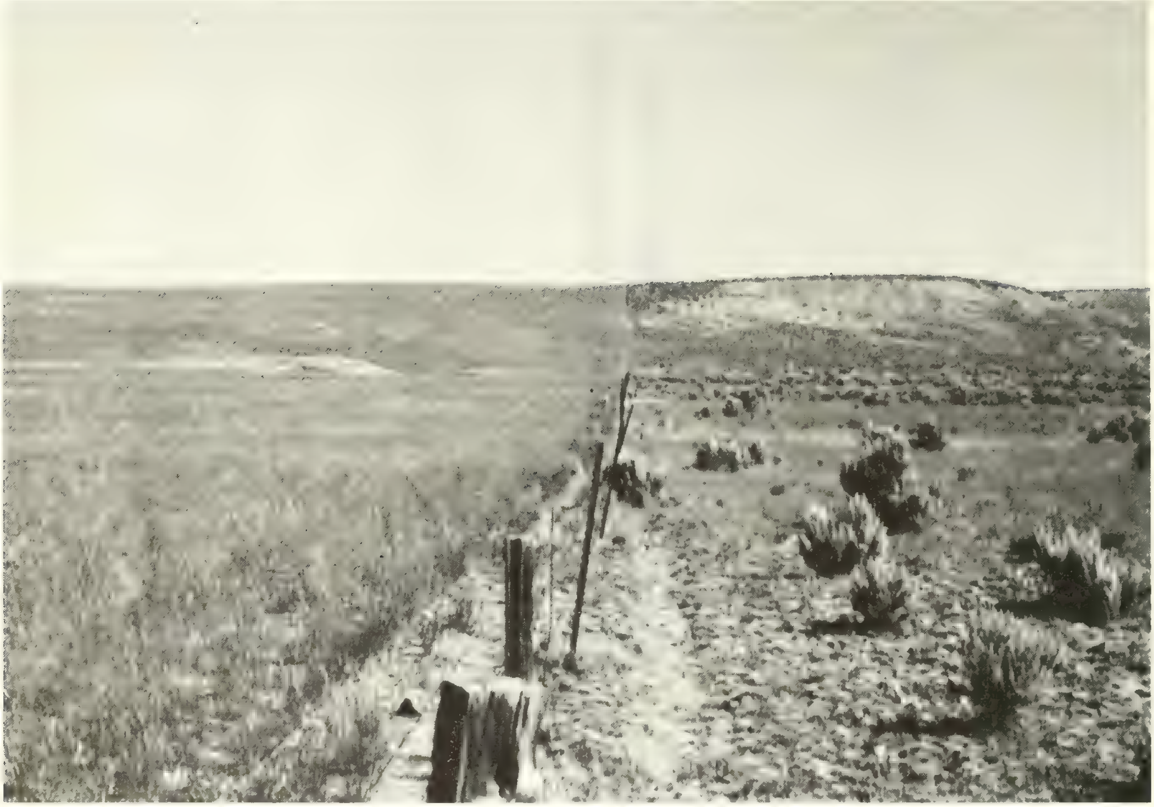


Figure 45.--Antelope seeding on the left and Brickey Springs seeding on the right. Small plants of big sagebrush in the Antelope seeding are about the same number per unit area as the larger plants in Brickey Springs.

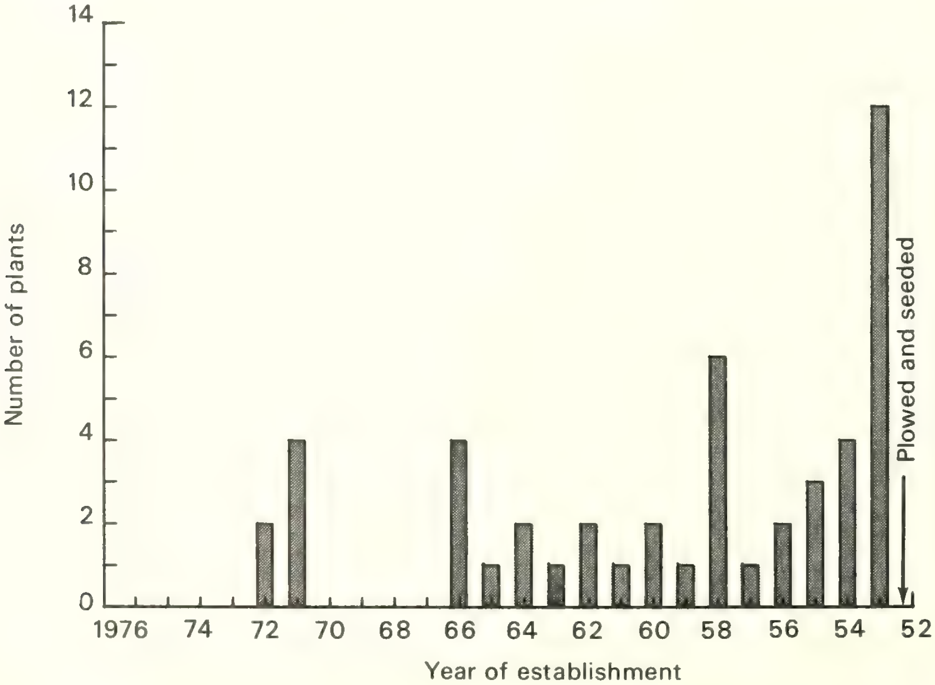


Figure 46.--Age-class distribution of big sagebrush, Ten Mile seeding project.

year of treatment. Plowing, spraying, and burning are all effective methods of big sagebrush control when used properly.

A reasonably effective brush kill can be expected to last indefinitely if properly managed and if a certain degree of big sagebrush cover is tolerable. Stands of grass usually appear to be deteriorating rapidly in the first few years following treatment. Most of the apparent reinvasion of big sagebrush, however, is actually the recovery of unkilled plants and the growth of seedlings established in the first few years following treatment. Seedlings established shortly after treatment generally remain small as adult plants. Growth of big sagebrush seedlings in stands with either well-established crested wheatgrass or excellent native bunchgrass is very slow, and many brush seedlings do not reach maturity. We believe that big sagebrush stands composed of less than 25-percent brush do not significantly lower the grazing capacity of associated crested wheatgrass or native grasses. If properly used, seedings containing big sagebrush should not significantly deteriorate unless brush cover increases beyond 25 percent.

Areas with nearly complete big sagebrush kills, especially those doubly treated--as spraying followed by wildfire--will return to brush slowly or not at all during a reasonable management timespan. Although a complete big sagebrush kill will result in an essentially permanent absence of big sagebrush, kills of between 90 and 95 percent allow seedlings to become established and significant mature plants to survive. We contend that the mixture of brush and grass will also be expected to have a long lifespan. Once the brush reaches equilibrium, generally within a few years, proper use will result in ample grass on a long-term basis.

Areas sprayed and then seeded to crested wheatgrass had much less brush than areas sprayed and not seeded, 0.22 and 0.33 plant/yd^2 (0.26 and 0.39/m^2), respectively. Before spraying, the spray-and-seed sites supported the heaviest brush stands and the fewest perennial grasses. The drilling operation certainly killed some brush plants, but higher density of perennial grasses following seeding resulted in less re-establishment of big sagebrush.

SUMMARY COMMENTS ON VEGETATION IN 1975

Condition and trend of the treated and untreated areas varied as did the rangeland itself. An argument can be made that thickening of stands and reinvasion by big sagebrush are causing a decline in range condition for domestic livestock. Although this is happening, we believe that management through control of stocking rates, animal distribution, and seasonal grazing systems will prevent the return of the big sagebrush to its pretreatment density. Stands of the large perennial grasses between the bushes will cause the invasion to stabilize at a probable brush cover of less than 25 percent, whereas it frequently was 50- to 60-percent cover before treatment. Few areas sampled showed concrete evidence of a downward trend. Plant vigor was excellent, and only one project area had significant numbers of dead desirable grasses. Sheet erosion was minor, and both erosion and pedestalling of plants were less in grazed areas than in the ungrazed exclosure west of Jordan Valley. Pedestalling of as much as 1 inch (2.5 cm) is normal for the perennial bunchgrasses in this area. Although we do not have survey data, we believe that at least 50 percent of the district is in good or excellent condition and that the trend of nearly all the district is either stable or improving.

Crested wheatgrass is stable or increasing in density in seeded areas. Only in China Gulch "B" seeding were any dead crested wheatgrass plants noted. Reproduction of crested wheatgrass over much of the Vale District was related to the present stand density. Seedings with more than four plants per square yard ($4.8/m^2$) rarely contained crested wheatgrass seedlings. Less successful initial seedings often contained seedlings, indicating stand thickening. Apparently, the maximum density of crested wheatgrass beyond which the stand does not thicken is about one plant for 2 square feet. Management practices intended to foster plant reproduction in these well-established stands wastes forage and are not needed. Crested wheatgrass shows little evidence of dying out, even under heavy use. We found none of the many seasonal patterns of grazing harmful to crested wheatgrass. It should be used in whatever pattern overall management requires.

Bluebunch wheatgrass also appears stable on treated areas. Not one seedling was found during sampling in the summer of 1975. Small plants occurred commonly, but none was unequivocally a seedling and not part of a broken larger bunch. Bluebunch wheatgrass has been reported to establish only in summers of higher than average rainfall (Harris 1967). Paired treated and untreated samples showed density to be 0.75 plant/yd^2 ($0.90/m^2$) in the brush and 0.96 plant/yd^2 ($1.15/m^2$) with little brush. Following spraying, large bunches which had grown under big sagebrush plants often broke into several smaller plants. The evidence, as observed in the field, suggests that bluebunch wheatgrass, although a bunchgrass, primarily increases by this vegetative means rather than by seed. We believe that moderate grazing helps this process. Bluebunch wheatgrass appears to be stable under the intensities of grazing practiced on the Vale District. The potential for further increase is not clear. Many areas, both with and without brush control, support excellent stands of bluebunch wheatgrass. Less well-stocked stands will slowly increase in grass density. Sprayed areas with densitie of bluebunch wheatgrass of less than one plant per square yard ($1.20/m^2$) appear to have more big sagebrush seedlings with the shrubs more actively invading than do treated areas with denser stands of native grasses. The eventual density of big sagebrush in the climax stands was discussed above. A dense stand of big sagebrush with numerous plants of bluebunch wheatgrass responds dramatically to a treatment of spraying and no grazing for 2 years. Two years of resting unspraye areas also brings dramatic response. Perhaps spraying alone has been overrated as a treatment of sagebrush-grass. This point will be explored later in conjuncti with costs and benefits of spraying.

The relationship between crested wheatgrass and the annual cheatgrass must be discussed. Some areas have little cheatgrass and others have dense stands. This pattern, obvious on a large scale, also occurs within small areas (fig. 47). Seedings with crested wheatgrass densities of less than three plants per square yard ($3.6/m^2$) were patchily infested with cheatgrass. Seedings with more than four plants per square yard ($4.80/m^2$) rarely had significant amounts of cheatgrass This annual formed dense stands where crested wheatgrass density was less than 1.5 plants/yd^2 ($1.79/m^2$). The mechanism of establishment of this pattern is not at all clear since cheatgrass seed occurs everywhere, and the periods of growth of both species differ significantly. A research study is needed on this point. Cheatgrass does fill a useful role in the poorer seedings, providing forage in some years, which rivals total production in successful seedings, and protecting the soil from erosion.

From a vegetational standpoint the Vale Program has been highly effective. Formerly dense and nearly pure stands of big sagebrush have been converted to grasslands on about 8 percent of the district. The additional forage provided

Figure 47.--Patches of cheatgrass occur and remain ungrazed where crested wheatgrass is in thin stands.

by improvement of range conditions gave the opportunity for flexibility in grazing use and further improvement in the untreated ranges. The district now produces more range forage than livestock harvest. The excess, however, provides stability against drought and needed cover and feed for wildlife. Some of the relationships with other uses of the land are examined next.

Multiple Uses and Relationships in the Vale District

LIVESTOCK

The Vale Program began with major emphasis on rehabilitation of soil and vegetation, conservation of water, and increased forage for livestock and wildlife. Clearly, the rangeland resource needed repair, regardless of the use to which it might be put. In 1962, that use was grazing by livestock and, in fact, major emphasis in the program aimed to improve livestock forage resources and livestock management. The accomplishments for 1962-75 are listed briefly as follows:

Big sagebrush plowed and seeded to crested wheatgrass	164,000 acres (66 400 ha)
Big sagebrush sprayed with 2,4-D	280,000 acres (113 400 ha)
Big sagebrush sprayed and seeded to crested wheatgrass	53,000 acres (21 500 ha)
Seedings for wildlife (legumes and browse)	58,000 acres (23 500 ha)
Seeded only and reseeded	8,000 acres (3 250 ha)
Fencing	2,000 miles (3 200 km)
Deep wells and water storage tanks	28
Pipelines	443 miles (709 km)
Reservoirs	574
Spring developments	428
Cattle guards	360
Roads	500 miles (800 km)

In addition to rehabilitation and construction of physical improvements, 28 grazing management plans have been formally accepted by livestock permittees and the BLM. All the remaining national resource grazing lands are in less formally controlled seasonal grazing plans.

The estimated grazing capacity of the whole district increased from 17 acres (6.9 ha) per AUM to 10.4 acres (4.2 ha) between 1962 and 1975, largely through removal of big sagebrush and increases in crested wheatgrass and the native perennial bunchgrasses. The task is not finished because large portions, mainly in the northern part of the district, remain in big sagebrush and cheatgrass. If all the vegetation were changed to something near the climax types, the overall grazing capacity might be 5-6 acres (2-2.5 ha) per AUM. The final result of the Vale Program, we estimate, will be about 8 acres (3.2 ha) per AUM.

The purposes for which the Vale District Program was established have been met in large measure. Livestock grazing caused the range deterioration in the first place, and the rehabilitation has restored much of the land into its once fully vegetated condition. The economy of the community depends on livestock, about a third of which grazes the public lands. Livestock grazing exceeds all other uses, the situation for over a century and one likely to continue.

To recognize that livestock is the principal use does not suggest that others of the multiple uses should be eliminated or reduced. Many are compatible with grazing by domestic animals, especially where fences, water, and riding permit manipulation of when, where, and how much grazing takes place. Grazing by domestic animals may be used as a tool to enhance the habitats for other species. Actually, other users, particularly wildlife, received increasing attention as the program proceeded. In addition to the seedings mentioned above, deep reservoirs provided permanent fish habitats. Goose nesting sites, fenced water, fence designs, and other practices favored wildlife. Eleven of the originally planned projects were eliminated because of probable damage to browse. Areas within projects were eliminated from treatment, including streambanks, canyons, deer winter ranges, sagegrouse concentration areas, and most of the low sagebrush vegetational type.

Although multiple use decisions from 1962 to 1973 may not suffice for 1975 or 1980 situations, the Vale Program attempted to be accountable to all users. The following sections examine the multiple use situations, as we found them. Mainly because few data were collected before and during the program, these analyses are inconclusive, and they depend largely on value judgments.

WILD HORSES

Thirteen horse management areas on the Vale District supported 2,416 wild horses according to counts made from an airplane on April 19, 1975 (fig. 48, table 16). Average band, family, or harem size was 7.6 head which ranged from about 4 to 11 mares per dominant male. Younger males may be in the band and single males may be found. About 15 percent of the horses were young foals. It is estimated that 10 percent of the colts are born in the fall and 90 percent in March, April, and May.

Horses have been regularly counted on the district, but with varying accuracy, since 1968 (table 16). Two herds, Jackies Butte and Three Fingers, which had been reduced in numbers, increased from 94 to 150 and from 66 to 225, respectively, in the 3-year period 1972-74 (table 17). Although inaccurate counting and addition of adults to the herds cannot be ruled out in either area, the major increase reflects natural reproduction. The data for Jackies Butte are believed accurate and they suggest a reproductive rate of 60 percent in 3 years or 20 percent per year. Wild horse herds throughout the Western States are known to have high rates of reproduction until feed becomes extremely scarce. Few deaths result from predators and diseases, and confined herds soon increase to and beyond the grazing capacity of their habitats.

In 1975, Cold Springs, Sheepheads/Barren Valley, and Jackies Butte had too many horses. The early signs of damage by horses, enlarged dusting areas and numerous trails, indicated deterioration where horses congregate in the Cold Springs area. Sheepheads/Barren Valley had deteriorating conditions within both winter and summer ranges, and Jackies Butte had denuded winter range area due to wild horses.

Table 16--*Counted numbers of wild horses in the Vale District, Bureau of Land Management, April 1975*

Number[1] and name of horse management area		Acres[2]	Number of horses			Percent foals	Average band size
			Adults	Foals	Total		
1	Hog Creek	18,120	64	6	70	8.6	6.2
2	Lake Ridge	2,720	11	1	12	8.3	6.0
3	Pot Holes	3,840	19	3	22	13.6	7.3
4	Basque	7,570	28	5	33	15.2	6.6
5	Cottonwood Basin	2,300	[3]0	0	0	0	0
6	Cottonwood Creek	5,660	49	9	58	15.5	8.3
7	Cold Springs	21,540	181	27	208	12.6	8.8
8	Atturbury	4,080	15	3	18	16.6	18.0
9	Stockade	26,866	49	5	54	9.3	10.8
10	Morger Allotment	26,172	128	19	147	12.9	8.2
11	Sheepheads/Barren Valley	639,770	952	176	1,128	15.6	6.9
12	Jackies Butte	78,094	186	36	222	16.2	8.8
13	Three Fingers	70,868	379	65	444	14.6	8.7
	Total	907,600	2,061	355	2,416	14.7	7.6

[1] Numbers refer to locations in figure 48.

[2] 1 acre equals 0.405 hectare.

[3] 67 horses claimed but ungathered.

Table 17--*Counted numbers of wild horses, Vale District, Bureau of Land Management*

Horse management area	1968	Spring 1969	Fall 1970	Winter 1972	Winter 1973	Spring 1974	Fall 1974
Hog Creek	--	--	--	[1]18	[1]35	[1]17	56
Lake Ridge	--	--	--	11	[1]4	[1]5	[1]5
Pot Holes	--	--	--	17	21	[1]4	19
Basque	--	--	--	6	6	6	28
Cottonwood Basin	--	--	--	2	0	--	1
Cottonwood Creek	--	--	--	19	34	[1]31	50
Cold Springs	--	--	--	[1]52	105	136	164
Atturbury	--	--	--	6	6	0	0
Stockade	--	--	--	10	13	42	47
Morger Allotment	--	--	--	80	85	132	154
Sheepheads/Barren Valley	--	--	--	539	660	1,217	--
Jackies Butte	--	225	263	[2]94	113	140	150
Three Fingers	364	[3]64	--	66	120	234	225

[1] Inaccurate.

[2] 181 head of horses removed in November 1970.

[3] 300 head of horses removed in fall of 1968.

We believe that too many free-roaming horses existed in the Vale District in 1975. They grazed to the extent of 28,000 AUM's on 900,000 acres (360 000 ha) designated for horses. Even distribution of grazing remains impossible to attain with wild horses; therefore, some areas become overgrazed and others not grazed at all. This situation is happening on the three areas mentioned above where numbers of horses should be reduced and maintained at lower levels. A reasonable balance between maintenance of the range and the horses should be attained with 2,000 horses, provided the three management areas receive most of the decrease.

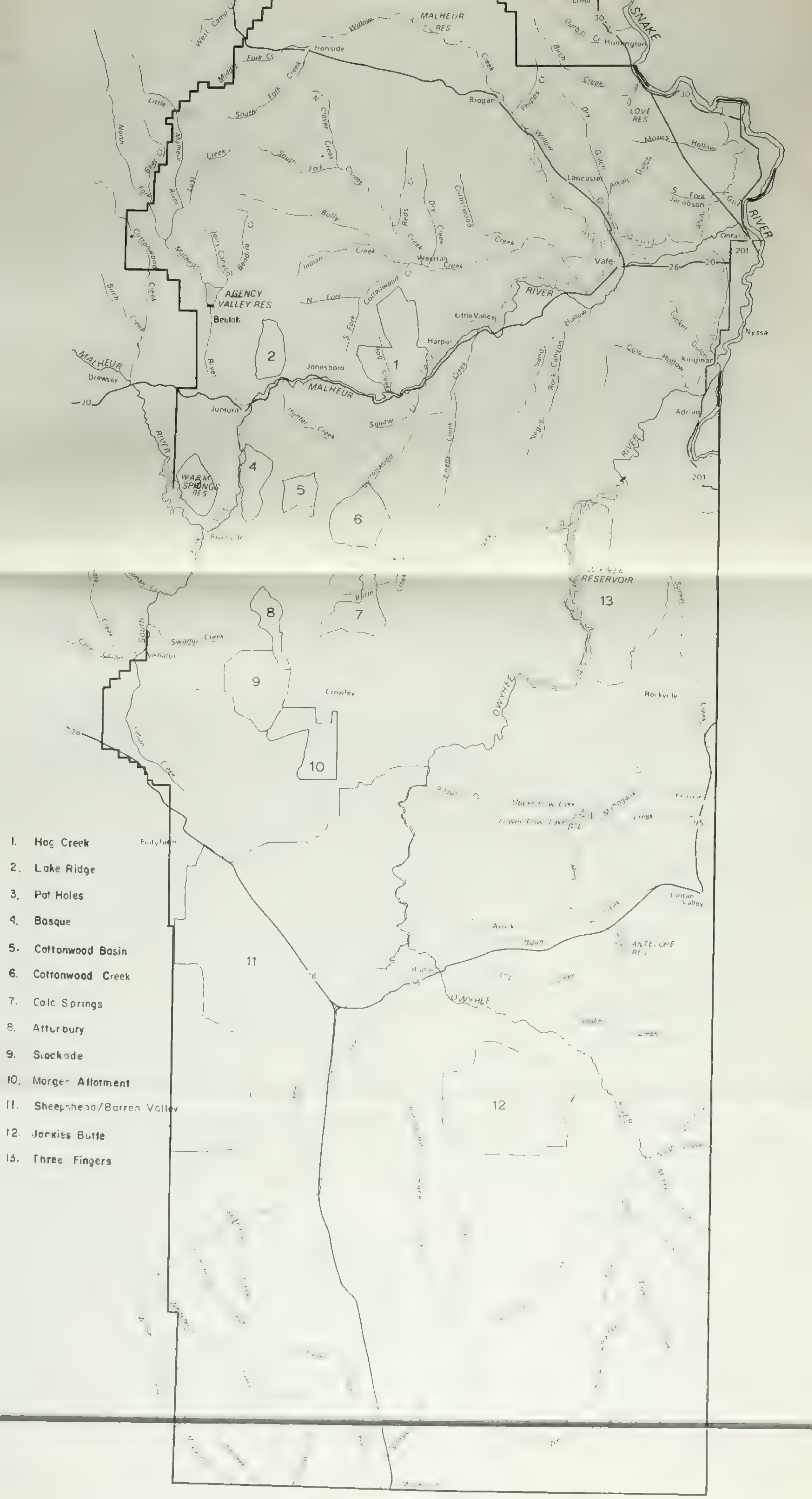


Figure 43.- Wild horse management areas.

Management of the horses has not been attained. They are creatures of habit and reuse the same trails and dusting areas many times; they paw, especially at springs and other water sources (fig. 49). Most will not go through a fence unless they are driven to it; however, many learn to crawl under or get through fences. The survey in 1975 found 181 head outside the management area boundaries.

Conflicts between needs of wild horses and those of other users potentially exist. Perhaps 8 percent of the grazing capacity is reserved for wild horses, and we doubt that any local person wants to eliminate them. However, they damage or cross over fences on snow during the winter. The BLM has scheduled gate-openings, removal of existing fences, and changed patterns of livestock grazing to favor the wild horses--not without concern and extra effort by the permittees. Wild horses, in isolated instances, have kept cattle away from water for short periods, but antelope have been observed at water with them. They pay little attention to coyotes.

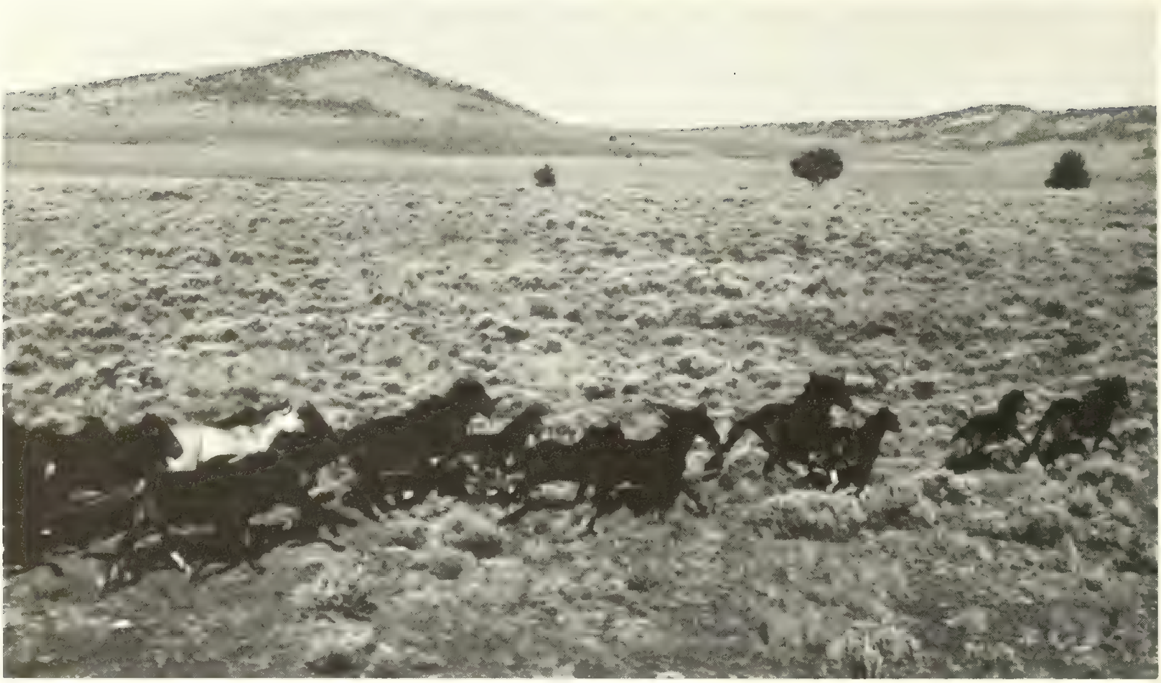
An unknown and possible conflict may exist because of overlapping diets with the ruminants. Wild horses consume mostly grass but they do feed on forbs and browse, especially in severe winters and when the grass is gone. They tend to "chase" after the early growth of annual grasses from low to high elevations as the growing season develops, thereby grazing too early and trampling wet soil. Cattle, not permitted on high ranges till summer, perhaps do not overlap with the wild horses on more than 20 to 25 percent of the range. Behavior conflicts between cattle and wild horses appear minor. Competition between the horses and bighorn sheep, antelope, and other wildlife is unmeasured and a matter for speculation only. A major effect is most likely to occur through grazing by horses which changes the available feed and cover for other species.

Recreationists make little onsite use of the wild horses. In one year, two persons separately and one party made pack trips to see the wild horses. Of course, many persons have some satisfaction in knowing that wild horses still exist on the Vale District. In actual fact, they are so well adapted to the terrain that their removal would be most difficult. The major problems are to keep them within the designated wild horse management areas and to prevent them from overgrazing their own habitats. Both problems are current and in danger of intensifying.

WILDLIFE AND FISHERIES

This section borrows heavily from an analysis of the wildlife situation in the Vale District by R. R. Kindschy (1971). Kindschy's paper summarizes available data to 1971. We have leaned heavily on Mr. Kindschy's personal observations in the Vale District since 1958, several years before the program started. He estimated in 1971 that 57,000 big game animals plus numerous upland game birds and nongame wildlife resided in the Vale Program area. The number of species is about 300. His analysis used data collected by the Oregon State Game Commission to determine the impact of the Vale Program on selected wildlife species.

Changes in vegetation because of overgrazing, which resulted in extensive and thick stands of brush with little grass, probably favored mule deer and blacktailed jackrabbit; but populations of both tend to be cyclic. Pronghorn antelope, sagegrouse, and bighorn sheep suffered from the increased brush. Bighorn sheep disappeared from the area about 1914 due to changes in vegetation, hunting, and scabies contracted from domestic sheep. Animal population numbers



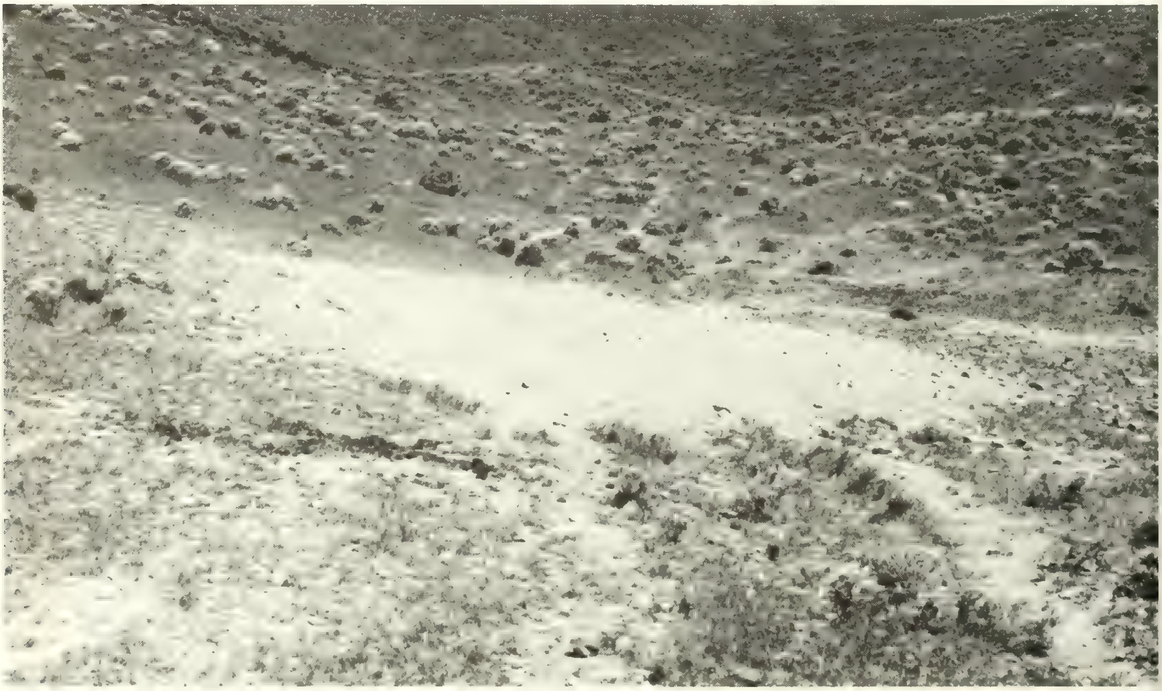


Figure 49.--Wild horses (top) damage the soil by trailing and pawing dust-bath areas (bottom) (Bureau of Land Management photos).

in 1962 reflected 100 years of many kinds of use and abuse. Animal responses to the Vale District Program give us an entirely new set of population numbers, which are analyzed in this section without implied desirability. Each may still be far different from those in the time before domestic livestock.

Mule Deer

Unusually high populations of mule deer occurred in the Vale District in the 1950's, as they did in other western rangeland. Fluctuations in numbers on the district have paralleled those of other districts, except for indications that reduction in numbers since 1973 has not been as severe as elsewhere (fig. 50).

The ratios of bucks to does appear to be decreasing more rapidly, from 36 to 19 bucks per 100 does on the Vale District, than on other areas in Oregon. That, however, is a drop of about 50 percent, just the same in the district as elsewhere in Oregon (table 18). The ratio continues to be higher in the district than in the remainder of Oregon. The number of fawns per 100 does remained relatively stable with a slightly higher ratio in the district than in other parts of Oregon until 1971, when the Vale District herd was highly successful. Fawns per 100 does were lowest in 1962. Low numbers of hunter days and relatively poor hunter success suggest two periods of low deer populations, 1966-68 and 1973-75 (table 19). The first followed a severe winter kill in 1964-65, great reductions in permits for antlerless deer, and reductions in hunting pressure. The reasons for the latest decline are unknown in the Vale District as they are elsewhere.

Figure 50.--Mule deer fawn (photo, courtesy R. Kindschy, Bureau of Land Management, Vale, Oregon).

Table 18--*Mule deer bucks and fawns on the Vale District and on other Oregon areas*

Year	Bucks per 100 does		Fawns per 100 does	
	Vale District[1]	Other Oregon[2]	Vale District[1]	Other Oregon[2]
1960	36	24	75	73
1961	38	20	94	73
1969	20	13	76	69
1970	19	12	74	68
1971	--	--	79	40

[1] Bureau of Land Management.

[2] Oregon State Game Commission annual reports.

Table 19--*Hunting pressure and hunter success for mule deer on Oregon State Game Management units which include the Vale District, Bureau of Land Management, 1961-75*[1]

Year	100 hunter days	Hunter days per deer	Hunter success
			Percent
1961[2]	57.3	--	70.8
1962	57.4	8.2	60.0
1963	31.5	5.3	59.0
1964	35.9	4.5	62.0
1965	27.3	6.1	48.3
1966	21.8	4.8	61.3
1967	19.5	4.9	47.3
1968	24.3	4.4	61.8
1969	33.2	5.9	47.8
1970	35.7	6.3	53.0
1971	54.1	10.8	43.8
1972	37.9	15.5	40.8
1973	37.3	14.0	28.3
1974	29.1	16.5	27.0
1975	17.7	16.0	26.0

[1] Oregon State Game Commission annual reports.

[2] Variable length of hunting season and variable limitations in legal bag among years reduces precision of data.

Many management decisions in the Vale District have successfully increased palatable browse. These include seedings of browse, no brush control at all on 11 projects, boundary lines changed to exclude browse from other brush controls, and minimized late summer and autumn livestock grazing on deer winter range. Kindschy (1971) found a 25-percent increase in available browse on 22 transects between 1963 and 1971. Mule deer often find grasses attractive during the winters and springs after fall growth. Crested wheatgrass, cheatgrass, and Sandberg bluegrass often produce sufficient green leaves in mild autumns to furnish feed for deer and other species later. In one example, deer have changed their migrations from the Three-Forks area (4,600 feet or 1 400 meters in elevation) to the Rome seedings (3,500 feet or 1 060 meters in elevation) to take advantage of the new feed. Uncontrolled brush and much browse still grow in the canyons, along the streambanks, and on steep slopes which surround and intermingle with the brush controls and seedings. The combinations of seedings, rejuvenating shrubs on them, and the uncontrolled brushlands appear to be attractive habitats for mule deer winter range (fig. 51). In a comparison of deer use before and after spraying of their summer range, Reeher (1969) found in the one example studied that spraying reduced deer use on a summer range. Seedings apparently received light use by deer except when heavy winter snows forced them to lower elevations.

In the period 1963-71, mule deer were estimated to have decreased from 57,000 to 44,000. These numbers are the broadest kind of estimates as no systematic efforts were made to count mule deer populations. Total herd numbers were determined by a formula which used hunting pressure, harvest data, and percentage of herd removal. After 1971, the general deer decline appears to be slightly less in the district than in other western mule deer herds. In general, mule deer exhibited the decline in population typical of the Intermountain west during the establishment of the Vale District rehabilitation program. They declined no more than in most other places. A conservative view is that the Vale Program had no great impact on mule deer populations.

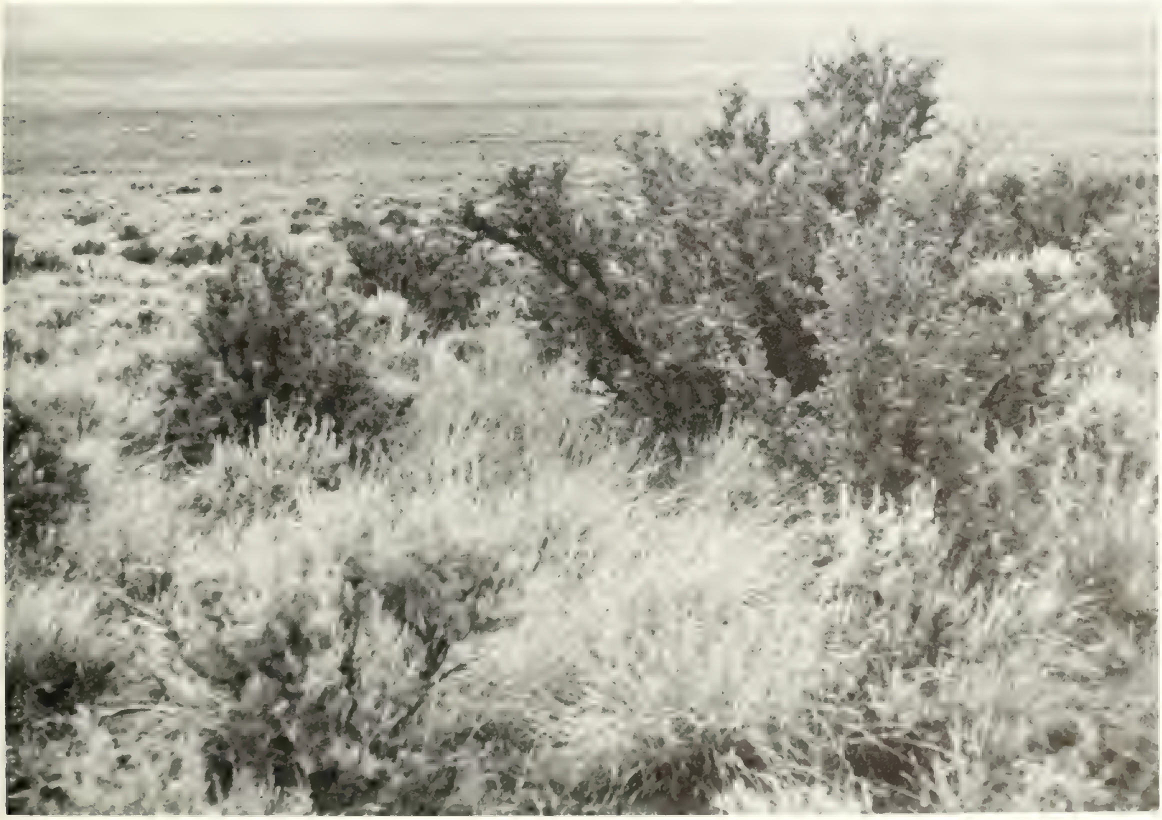


Figure 51.--A mixture of bitterbrush, big sagebrush, and bluebunch wheatgrass on winter deer range.

Pronghorn Antelope

The dramatic increase in pronghorns during the course of the Vale Program and under increasing hunting pressure has been a most impressive wildlife phenomenon (fig. 52). The population increased 2.6-fold and the hunters by three times without diminishing the hunter success from 1961 to 1975 (table 20). The largest population was reached in 1968. Pronghorn antelope were seldom seen in the early 1900's.

In 1970, the Vale District had 143 percent more antelope than in 1962, but other eastern Oregon antelope populations had increased only 50 percent. A census showed that numbers had increased from 0.9 to 2.0 antelope per mile (1.6 km) of transect on the Vale District but the level of their occurrence was constant in

Figure 52.--Antelope buck (Bureau of Land Manageme photo).

Table 20--*Numbers of antelope and hunter success in the Vale District, Bureau of Land Management, 1961-1976*

Year	Number of antelope	Number of permits	Hunter days	Hunter success
				Percent
1961	947	--	532	56
1962	1,445	175	386	63
1963	1,800	175	374	60
1964	2,039	200	389	64
1965	2,321	200	448	65
1966	2,615	250	502	73
1967	2,823	250	494	56
1968	3,315	250	500	66
1969	2,840	300	623	70
1970	2,957	500	924	60
1971	2,840	525	1,017	62
1972	2,831	525	991	61
1973	2,956	625	1,166	59
1974	2,504	625	1,164	58
1975	[1/] 1,523	625	1,104	52
1976	2,979	625	--	--

Source: Oregon State Game Commission.

[1/] Inaccurate census due to weather conditions in 1975.

the remainder of Oregon. The actual hunter harvest increased from 123 to 249 (1961-71) on the district but only from 295 to 387 in the other parts of eastern Oregon during the same period. Each hunter averaged 2.4 days of hunting.

Observations indicate that antelope prefer places where brush has been removed and crested wheatgrass seeded. Young, tender growth of grasses and forbs attracts them. They are frequently seen in areas closely used by cattle.

Nomad alfalfa has been seeded with crested wheatgrass on 56,340 acres (22 818 ha) on 36 separate areas in the Vale District, and it is highly preferred by antelope and other animals (Vale District Manager 1974). The common seeding procedure was to plow sagebrush in the spring, plant crested wheatgrass in the autumn, and aerially spread inoculated alfalfa seed at 1 lb/acre (1.1 kg/ha) the following spring. A survey of 20 of the seedings in 1973 and 1974 revealed that nomad alfalfa composed 10.7 percent of the vegetation present on 12 of the seedings where it was encountered, but it had completely failed or was minor in 8 of the projects. Apparently once established, the alfalfa can persist unless blacktailed jackrabbits dig out the crowns, but its actual persistence is unknown. Our observations suggest less alfalfa present in 1975 than was reported in 1973-74 but the differences may have been due to season or method of sampling. A particularly important characteristic of alfalfa is that it stays green and highly nutritious all summer.

Plowing of sagebrush and seeding to crested wheatgrass attracts antelope for a few years after the operation, probably because of high forb content in the vegetation. Antelope abound on the rehabilitated Cow Creek and Soldier Creek units and on the Antelope Flat and Deer Flat units which are native sagebrush-grass range in excellent condition (Reeher 1969). These animals avoid tall stands of big sagebrush, preferring low stands and the short species of sagebrush. Some ranges do not attract antelope in either the native brush or seeded stands. For example, the Starvation spray-and-seed project, which lies between winter and summer range, received little use by antelope before and after treatment. Antelope moved from the Chicken Creek plow-and-seed project to adjacent areas in the year of treatment, but returned the following year and remained in large numbers (Reeher 1969). It appears that plowing and seeding makes better antelope range than either spraying or spraying and seeding.

Antelope frequently drink at livestock watering points. Undoubtedly, provision of dry-season water has permitted antelope to use areas in the summer which were not formerly available to them. Additional water provided in the Vale Program may have benefited the antelope as much as any other practice. Fences appear not to restrict antelope movements.

Bighorn Sheep

Seventeen California bighorn sheep were reintroduced in November 1965 into the Mahagony unit at Leslie Gulch along the east side of Owyhee Reservoir. The actual count was 53 (11 rams, 25 ewes, 17 lambs) in 1971, increasing from 6 rams, 8 ewes, and 3 lambs in the original group which came from the Hart Mountain Refuge. Over 100 sheep were estimated in the herd in 1974, but cursory search revealed only 20 in 1975 (fig. 53). They are elusive animals, and many could have been missed in the rugged topography. Some were believed to have migrated to new ranges

Bighorn sheep have not extended their range into the brush controls and seedings but are on native ranges which have improved during the program. Range management practices, including controls of livestock numbers and seasons of grazing, apparently have fostered return of near-climax sagebrush-grass and permitted bighorn sheep to do well. Hunters were allowed to draw for two permits (rams with three-quarters curl or better) in 1973-74 and four permits in 1975.

Rocky Mountain Elk

Migratory herds, estimated at 100 head, enter the district during the winter but numbers vary with severity of winter. Little potential elk habitat, especiall summer range, exists on the Vale District and there need be little concern for elk in this area.

Blacktailed Jackrabbits

The last peak in jackrabbit populations in the Vale District occurred in 1957-58 when large numbers invaded farmlands, causing thousands of dollars in losses to the farmers and overuse to rangelands. Neighboring areas in both Oregon and Idaho have experienced subsequent but less severe increases in populations of jackrabbits.

Reasons for the failure of cycling on the Vale District and lack of synchronism with cycles in other districts are unclear. Present jackrabbit populations appear to be low and stable. They are known to prefer brush-covered lands with little grass (fig. 54). The change in range condition from poor to good or excellent for livestock may have greatly reduced favorable jackrabbit habitat in the Vale District. Reeher (1969), after comparing four rehabilitation projects with nearby untouched brushland for 6 years, concluded that the projects did not affect cottontail and jackrabbit populations or their use of an area. Sagebrush cover provided greater winter protection for them than the grasslands.

Figure 53.--Bighorn sheep (Bureau of Land Management photo).

Figure 54.--Jackrabbit (Bureau of Land Management photo).

Chukar Partridge

Chukars were introduced into the Vale District in the 1950's and have since found their way to many if not all suitable habitats. Data from the annual reports of the Oregon State Game Commission (1962 and 1970), as compiled by Kindschy (1972), show that the numbers of chukars in the Vale District were higher than in other eastern Oregon areas and that they increased twofold during the Vale District Program but only by one-fifth outside the district (table 21). In 1969, an estimated 48,000 birds were taken by hunters in the Vale District.

Chukars feed on insects and seeds. Cheatgrass and crested wheatgrass seeds commonly occur in their diets, but grass and weed seeds abound everywhere. It is doubtful if the rehabilitation project markedly affected their population numbers (fig. 55). Chukars prefer rocky slopes, talus, and steep escarpments--during winter those facing south. These topographic types were omitted from the rehabilitation projects. The mobility of the birds permits them to feed in the seedings and return to their favorite habitats.

Kindschy (1971) believes that development of water for livestock was the practice giving greatest benefits to chukars. Reeher (1969) found that spraying of sagebrush did not reduce chukar use of an area and may have increased it. Variable use from year to year prevented more definite conclusions from Reeher's study.

Sagegrouse

The population dynamics, ideal habitat conditions, and impacts of rangeland rehabilitation on sagegrouse are little understood in the Vale District. Many thousands of birds inhabited the area in the 1920's and 1930's. They nearly disappeared in the 1940's and 1950's but have been increasing since. The increase was estimated to be over 100 percent from 1961 to 1970, but similar kinds of census data suggested a 60-percent decrease in the remainder of eastern Oregon (table 21). In 1971 the Vale District was the only area in eastern Oregon that had an open hunting season for sagegrouse. The Oregon State Game Commission reported 1,090 sagegrouse taken in the Vale District during the 1969 season.

Table 21--*Average numbers of chukar partridge, sagegrouse, and valley quail counted per 10-mile (16-km) transect of the Vale District Program, 1961-62 and 1968-70*[1]

Item	1961	1962	1968	1969	1970
Chukar partridge:					
Vale District	42	51	170	126	127
Other eastern Oregon	24	15	28	22	21
Sagegrouse:					
Vale District	69	33	132	92	95
Other eastern Oregon	23	37	15	7	14
Valley quail:					
Vale District	14	8	40	22	29
Other eastern Oregon	40	18	28	8	20

[1] From Kindschy 1972.

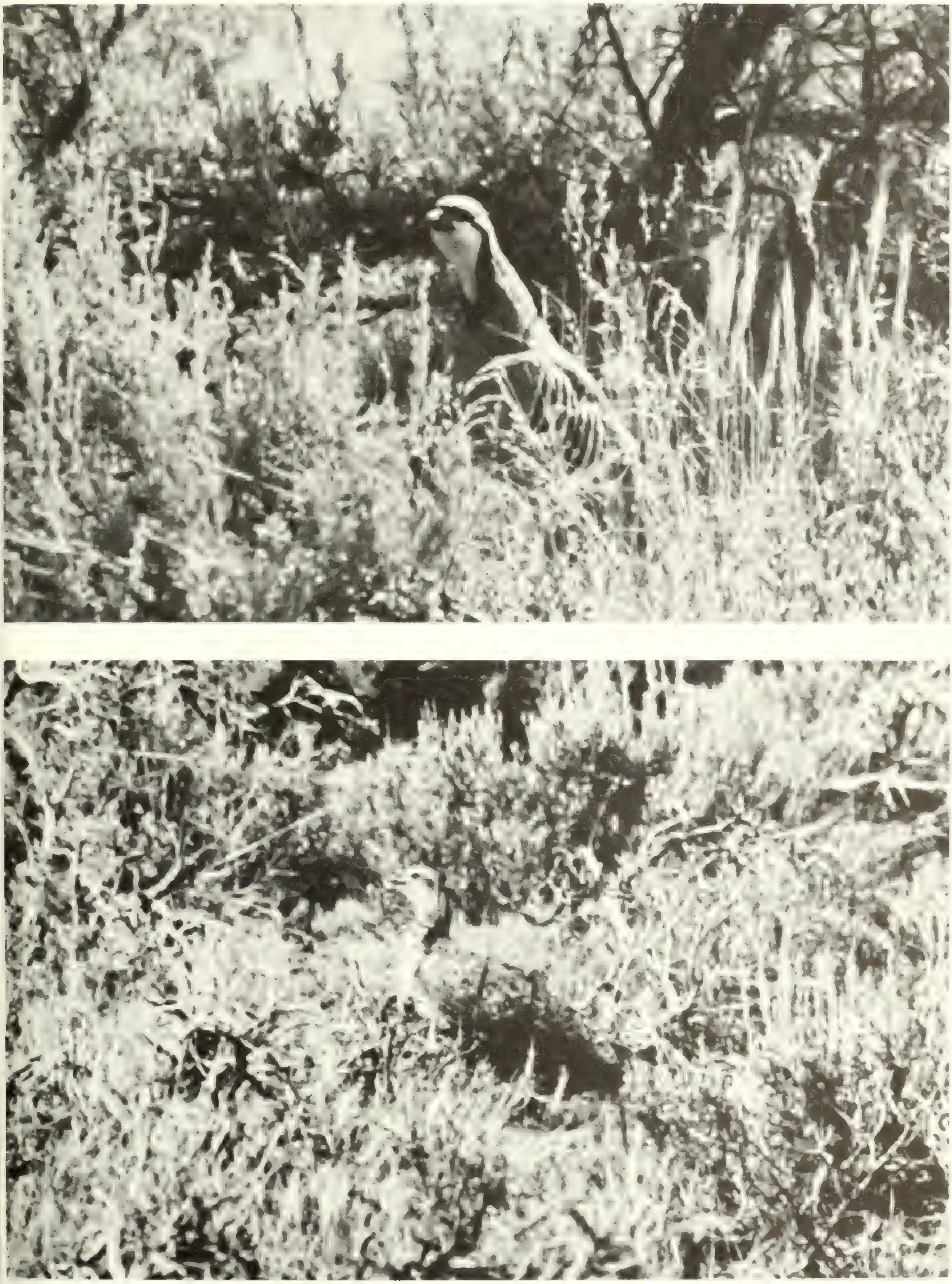


Figure 55.--Top, chukar partridge; bottom, sagegrouse (Bureau of Land Management photo).

Sagegrouse use big sagebrush for food and cover, especially for nesting and in the winter, but apparently large areas of continuous big sagebrush are marginal sagegrouse habitat and reduction of wide expanses of brush causes little loss of their habitats (fig. 55). They need meadows, seeps, and open areas along the valley bottoms as well as the big sagebrush. Many are found along the edges and in hay and grain fields. Concentrations of livestock, which damaged the meadows, may have caused more loss of sagegrouse habitat than overgrazing in wide expanses of brushlands. Reeher (1969) found that spraying and spray-seed operations reduced use by sagegrouse, but it increased following the plow-seed operations. Overall sagegrouse populations are greater than they were before the program began in 1962, a situation not matched in other parts of eastern Oregon.

Quail

Both the valley or California quail and the mountain quail occur in the Vale District. Both species fluctuate widely in population numbers. The valley quail increased during the course of the rehabilitation program (table 21). Lack of data and even of opinions prevents comment on the uncommon mountain quail.

All the rehabilitation projects stated that streambank and other shrub vegetation along the valley bottoms must be retained. Therefore, the principal native cover of the valley quail was preserved. Rotational grazing has fostered more vegetation in sites where cattle normally concentrated along the streams. Improved habitat for valley quail has resulted, but we doubt that the rehabilitation projects reached into the mountain quail habitats.

Waterfowl

Mallard and teal have benefited from at least 624 of the reservoirs on the district, many of which are 1 to 4 surface acres in size. A few have been fenced to exclude livestock use from the pond edges where increased vegetational cover provides nesting sites for waterfowl. Rotational grazing and no spring to early summer grazing often gives the same protection as fencing to the nesting birds but on an irregular basis. Most of the reservoirs should have been equipped with a pipeline and trough for livestock watering and fenced at the time of construction

The Rock Creek Reservoir, a large, shallow pond near Jordan Valley, and over 200 acres (81 ha) of fenced land around it provide protection for a small population of Canada geese. Construction included 18 islands for nesting sites which are regularly used (fig. 56). In 1971 over 50 goslings were observed at the sites.

Ground Squirrels

Several species, but principally *Spermophilus townsendii*, occur ubiquitously and in large numbers within the Vale District. They prefer the sandy loam soils and lacustrine sediments. Although these rodents usually cycle, high numbers have been sustained since 1968 on several crested wheatgrass seedings near Vale. Forage for livestock may have been reduced but permanent effects on the grass stands appear to be minor. These rodent populations furnish recreational shooting for local residents and their continued abundance has permitted an increase in predators, especially raptorial birds.

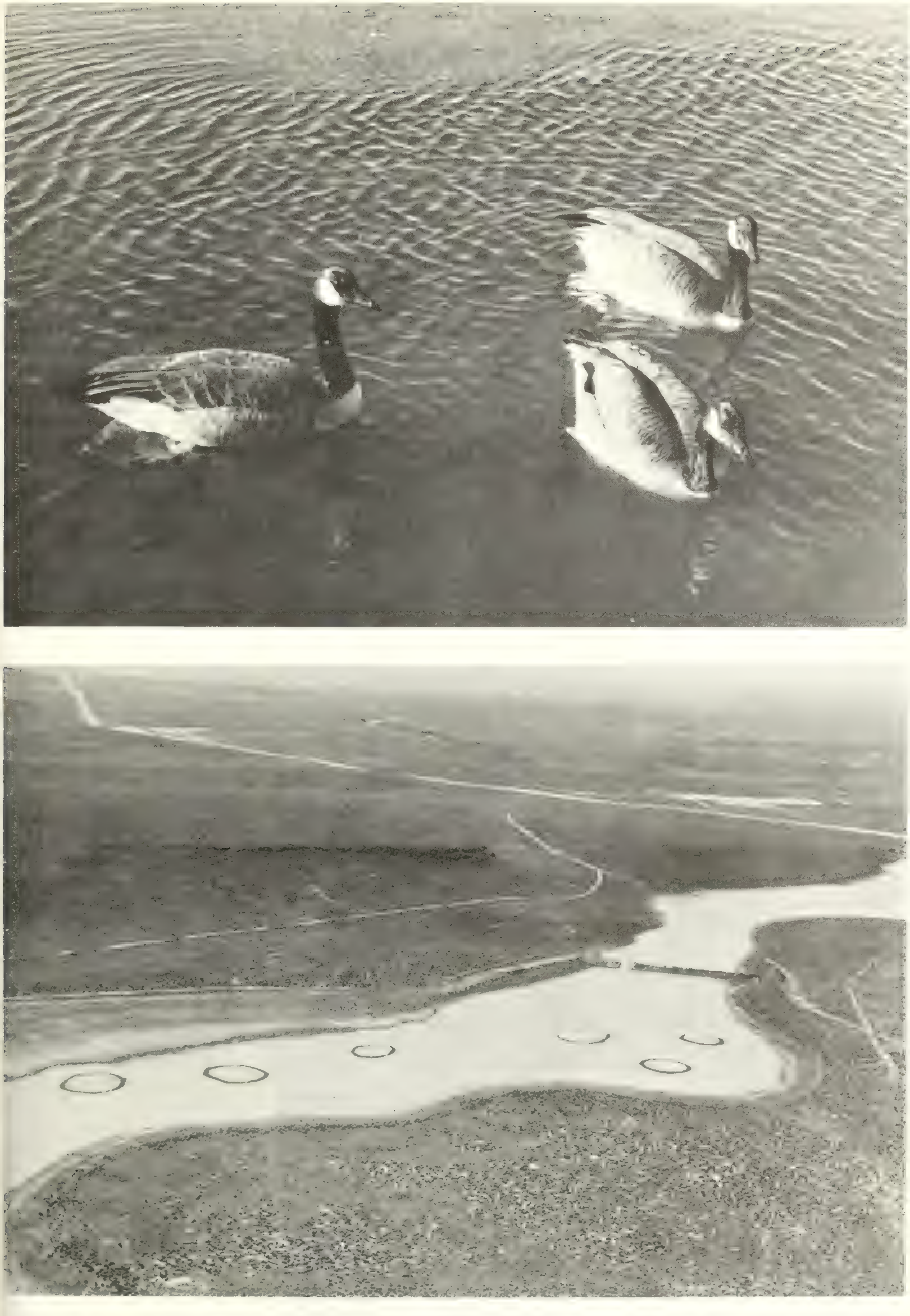


Figure 56.--Canada geese (top) and nesting sites constructed for them (bottom) (photos, courtesy R. Kindschy, Bureau of Land Management, Vale, Oregon).

Raptorial Birds

No census data are available on raptor populations, and none are being collected. Local wildlife people generally agree that populations are higher than at any time they can remember. Numerous golden eagles; rough-legged, redtailed, and marsh hawks; prairie falcon; and several species of owls can be found with little effort. Sustained ground squirrel populations supply their food, and national publicity for preservation has increased their chances for survival.

Other Predators

A recent high in the observed, but not counted, coyote population may be diminishing, as few young animals appeared in 1975. Abundance of ground squirrels and reduced predator controls contributed to the high population; but reasons for a decline, if one exists, are unclear. Bobcat populations peaked about 1960, dipped to a low in 1968-69, and now are believed to be recovering (fig. 57).

Figure 57.--Bobcats (photo, courtesy R. Kindschy, Bureau of Land Management, Vale, Oregon).

A timber wolf (identified at the Smithsonian Institution) was shot in 1973. Mountain lions occur rarely. Badgers and long-tailed weasels associate with rodents, their principal food supplies. Skunks and raccoons depend more on cultivated areas than on native rangelands.

We estimate that effects of the rehabilitation program upon predator populations have been minor. Increases in some species at a few locations might be due to increased rodent populations which in turn resulted from less brush and more grass than in the early 1960's or before. The chain of events cannot be proved because other factors have contributed to the changes. A negative conclusion seems more reasonable--apparently the rehabilitation program has not reduced the populations of predators.

Fisheries

The Oregon State Game Commission takes responsibility for fisheries work within the district, and the BLM actively cooperates with technical assistance and limited project construction. Treatment of both the Malheur and Owyhee Rivers removed nongame or rough fish; and restocking included rainbow trout, smallmouth bass, and channel catfish, with little involvement in the rangeland rehabilitation program.

The Alvord cutthroat trout, a threatened subspecies, occurs naturally in three streams in the Oregon Canyon Range near the southwestern corner of the district. Fencing of critical portions of the riparian habitat has been accomplished through special funding and the fish has been successfully released in other suitable habitats. Trash catchers in some of the streams result in resting pools for improved pool/riffle ratios.

The Vale District contains approximately 6,500 surface acres (2 630 ha) of natural lakes and reservoirs, many 2 to 5 acres (0.8-2.0 ha) in size. Some have been fenced and planted with rainbow trout. The BLM constructed Squaw Creek Reservoir specifically for a fishery, and it has been a successful recreational project.

Since livestock naturally congregate along the streams and damaged these locations in the past, only intensive rangeland practices can successfully repair many riparian sites. On the Vale District, rotational systems of grazing and abundant forage on thousands of acres have reduced grazing pressure and permitted vegetation to return on streamside sites, the water to carry fewer sediments, and streambed scouring to decrease. More places have flowing water throughout the summer. Fencing of some areas is still needed to allow full growth of riparian vegetation. Sport fishing as provided, protected, and improved by the Vale District Program has become a popular activity in the region (fig. 58). Many drive miles over poor roads to fish in a relatively small pond.

An Overall View

Wildlife data available to support the analyses and conclusions in this section leave much to be desired. Few numbers were available for the periods before 1962 and after 1971. Many projects started after 1971, and the effects of all extended beyond that time. Our statements use those data, views expressed by wildlife biologists, and our own assessments. We believe that antelope and sagegrouse have benefited by the project treatments, although their numbers and

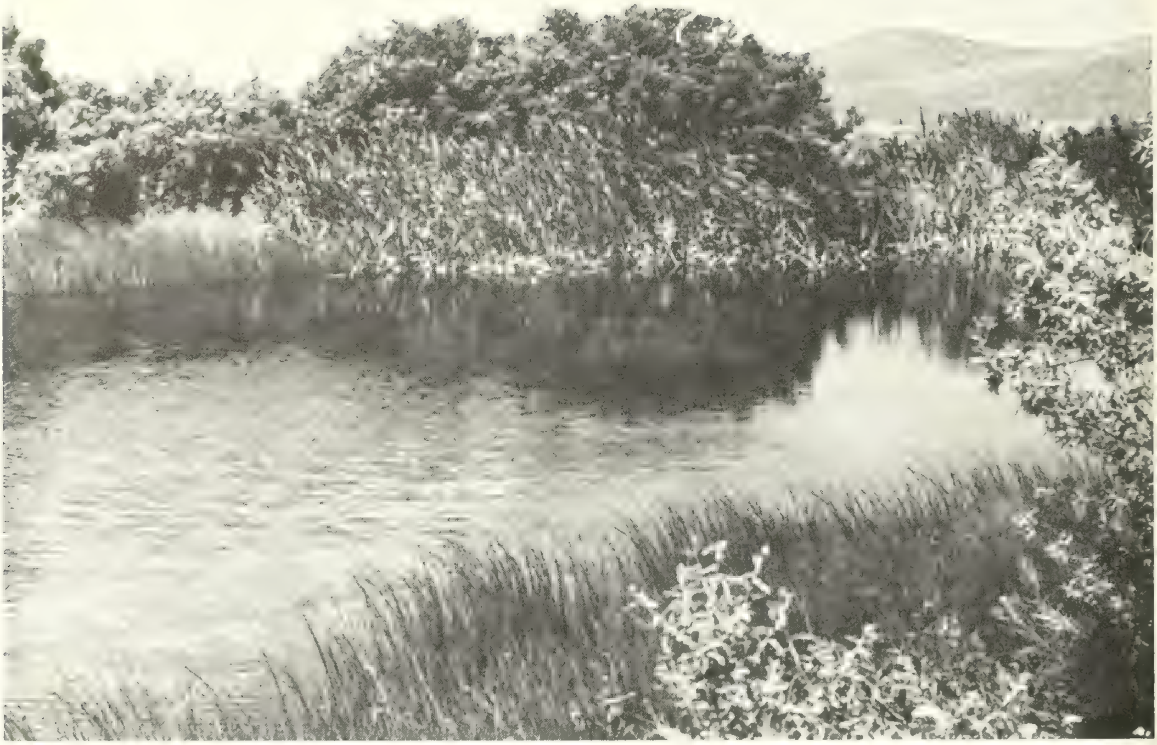


Figure 58.--A constructed reservoir which has been protected to provide wildlife and fish habitats (photo, courtesy R. Kindschy, Bureau of Land Management, Vale, Oregon).

and their movements may have been temporarily interrupted or even changed. Mule deer numbers may not have changed greatly, although we suspect favorable responses before 1971 and less decline in the herd on the Vale District than in other places after 1971. Many mule deer in the district depend in part on hay meadows, grain fields, and other irrigated crops, which were only indirectly influenced by the rehabilitation projects. Widespread native range improvement but not rehabilitation projects *per se* contributed to the successful release of bighorn sheep. Sagegrouse have increased, although their numbers are still small. Valley quail expanded in both range and numbers during the program. Water and streamside site management practices have improved the fisheries and quail habitat. We find every animal species on which data or opinions existed to have increased or to be unchanged because of the Vale District Program.. The collared lizard may be an exception as it prefers bare ground, much less of which exists since the program ended. Perhaps the large areas of grass discourage jackrabbits. Our concern is the continued lack of pertinent data on the wildlife responses to particular factors which cause change.

The importance of the management of public lands for wildlife has gradually increased in the Vale District Program during the last 20 years, largely because of three factors: (1) A professional wildlife manager has been a part of the team throughout the program. (2) Increased knowledge of wildlife requirements has accumulated. (3) The public has demanded that attention be given to wildlife. The continuing inability of professional people to predict effects of rehabilitation practices on wildlife populations in the district contributes more than any other factor to controversy between wildlife enthusiasts and other land users.

Another problem is the lack of a conceptual framework which allows consideration of all vertebrates in the planning process and the retention of an emphasis on management of a single or a few species. Still another problem is the lack of a definition of "ideal habitat" for each species. If ideal habitat were known, it could be attained through land management (Thomas et al. 1976). These problems define specific needs and work is beginning on this subject by a team in the district. Continued generalized criticism by one user group of another will not help attain these needs whether they are wildlife vs. livestock or some other multiple use controversy.

The full integration of wildlife planning into the management of rangeland on the Vale District should recognize several realities: (1) Livestock grazing is, and likely will remain, the principal land use of the district; (2) wildlife management is the management of habitats, mainly vegetation, because public land administrators and private landowners cannot by law control wildlife numbers; (3) livestock grazing management constitutes a powerful tool in the favorable management of habitats for wildlife; (4) viable populations of wildlife and reasonable livestock production will result from coordinated effort. The managers of rangeland need to be able to predict impacts and outcomes of each of their actions before doing or not doing a job.

THREATENED AND ENDANGERED SPECIES

Species of vertebrate mammals in southeastern Oregon which have been listed as threatened and endangered are Merriam shrew, white-tailed jackrabbit, Richardson ground squirrel, little pocket mouse, northern grasshopper mouse, and the sagebrush vole (Dyrness et al. 1975). All but the white-tailed jackrabbit appear to be in low numbers due to natural causes. That publication also includes a list of references that describe the species and where they might be found. A study is underway to determine if the long-billed curlew should be added to the threatened list. The bird nests in grass stands on alkaline soils along the Malheur River west of Vale. Data on either good or bad influences on these species resulting from the Vale District Program, or any management program, do not exist.

A list of vascular plants of special interest includes 17 species (table 22), 10 of which occur on the national list of threatened and endangered species prepared in 1974 (Smithsonian Institution 1974). A majority of those plants were originally collected on bluffs and in the canyon of the Owyhee River, which provides maximum protection from grazing, fire, and other land management practices. The canyon wall effectively prevents livestock use, and man himself can reach much of the area only with great difficulty. It is and will remain an effective wilderness or research natural area, even without official designation. The Jordan Craters were set aside in 1975 as a Research Natural Area.

Gathering of field data on threatened and endangered species of all kinds in the Vale District constitutes a continuing study which should be funded separately and justified on its own values. Very likely, more species would be found in such a study than are presently on the lists.

Table 22--*Vascular plants that may be threatened and endangered in the Vale District*

Species	Distribution
Astragalus iodanthus var. *vipereus*	Bluffs, eastern Malheur County
Astragalus mulfordae[1]	Dry sandy ground, lower Owyhee River, eastern Malheur County
Astragalus nudisiliquus	Gravelly bluffs, northeastern Malheur County
Astragalus purshii var. *ophiogenes*[1]	Sagebrush desert, Owyhee River, Malheur County
Astragalus solitarius[1]	Usually in sagebrush, Owyhee River, Malheur County
Astragalus sterilis[1]	Clay hills, Succor Creek, Malheur County
Cryptantha propria	Dry hillsides, northern Malheur County
Cymopterus corrugatus[1]	Dry hills, southern Malheur County
Eriogonum novonudum[1]	Stony clay hills, eastern Malheur County
Eriogonum ochrocephalus ssp. *calcareum*	In loose, white volcanic ash, Malheur County
Hackelia cronquistii[1]	Unknown
Hackelia ophiobia[1]	Cliffs, Three forks of Owyhee River, Malheur County
Hackelia patens	Between Vale and Harper, Malheur County
Mentzelia mollis[1]	Clay slopes, eastern Malheur County
Mirabilis bigelovii	Canyon of Owhyee River, Malheur County
Silene scaposa var. *lobata*[1]	Unknown
Trifolium owyheense	Dry slopes, Succor Creek, Malheur County

Source: Dyrness et al. (1975).

[1] Species list of threatened and endangered plants (Smithsonian Institution 1974).

Table 23--*Major recreational areas in Malheur County dependent on lakes*

Name of facility	Nearest town	Surface acres[1]	Improvements	Species	Access
Antelope Reservoir	Jordan Valley	3,000	Park, Bureau of Land Management	Trout	Dirt roads
Bully Creek Reservoir	Vale	1,000	Boat ramp and park	Trout	Oiled road
Beulah Reservoir	Juntura	1,900	Boat ramp	Trout	Gravel road
Batch Lake	Jordan Valley	50	None		
Coyote Hole Reservoir	McDermit				
Cow Lakes	Jordan Valley	975	Boat ramp Picnic facilities	Trout	Gravel road
Chapman Reservoir	Riverside	18		Bass	Dirt road
Dunaway Pond	Adrian	5		Bass-bluegill	Dirt road
Granite Creek Reservoir	Riverside	15		Bass	
Littlefield Reservoir	Harper	34		Trout	
Malheur Reservoir	Brogan	1,400	Roads, pit toilets	Trout	Gravel road
Murphy Reservoir	Beulah-Juntura	15		Trout	Dirt road
North Indian Creek Reservoir	Westfall	40		Trout	Dirt road
Odom Reservoir	Jordan Valley	40			
Owyhee Reservoir	Nyssa	12,700		Bass-crappie	
Leslie Gulch	Adrian			Bass-crappie	Gravel
Dry Creek Arm	Vale			Bass-crappie	Dirt
Resort and State park	Nyssa		Boat ramps Picnic and overnight	Bass-crappie	Paved
Deadman's Gulch	Vale		Airstrip	Bass-crappie	Road not pasb
Pole Creek Reservoir	Brogan	60	Pit toilets	Trout	Dirt road
Rattlesnake	McDermit	10		Trout	Dirt road
South Cottonwood Reservoir	Harper			Trout	Dirt road
Squaw Creek Reservoir	Harper			Trout	
Vaughn, South Indian Creek	Westfall	50			Dirt road
Warm Springs	Juntura-Riverside	4,400	Boat ramp and overnight, etc., in Harney County	Trout-perch Bass	Dirt and gravel roa

[1] 1 acre equals 0.405 hectare.

RECREATIONAL USES

The proposal for the Vale District Program stated that 55 tracts would be developed for recreational purposes (fig. 59)--42 were essentially water- and canyon-based sites to be developed for family camping, picnicking, hunter camping, and scenic qualities. Plans called for facilities such as parking, tables, sanitation, and potable water. The other 13 sites included a historic monument, wilderness areas, and natural preserves. Certainly, most of the planned roads, cattle guards, and many of the small reservoirs could have been listed for their values to recreationists. Recreational use in 1961 amounted to 60,000 visitor days.

Recreationists generally congregate around large bodies of water, such as the Owyhee, Antelope, and Bully Creek Reservoirs, for three main purposes--camping, boating, and fishing (table 23, fig. 60). Hunting brings large numbers of persons to the public lands, many from outside the county. River rafting on the Owyhee has recently increased. Rock hounds from all over the United States are increasing their searches for geodes, petrified wood, agates, jasper picture rocks, and other minerals. Traffic counters now record roughly 250,000 visitor days per year in the Vale District, four times the number in 1961.

During the 15 years since the original recreational survey and planning, many changes have become necessary. Perhaps no more than half of the original sites were completed as recreational facilities. For those that were, construction of

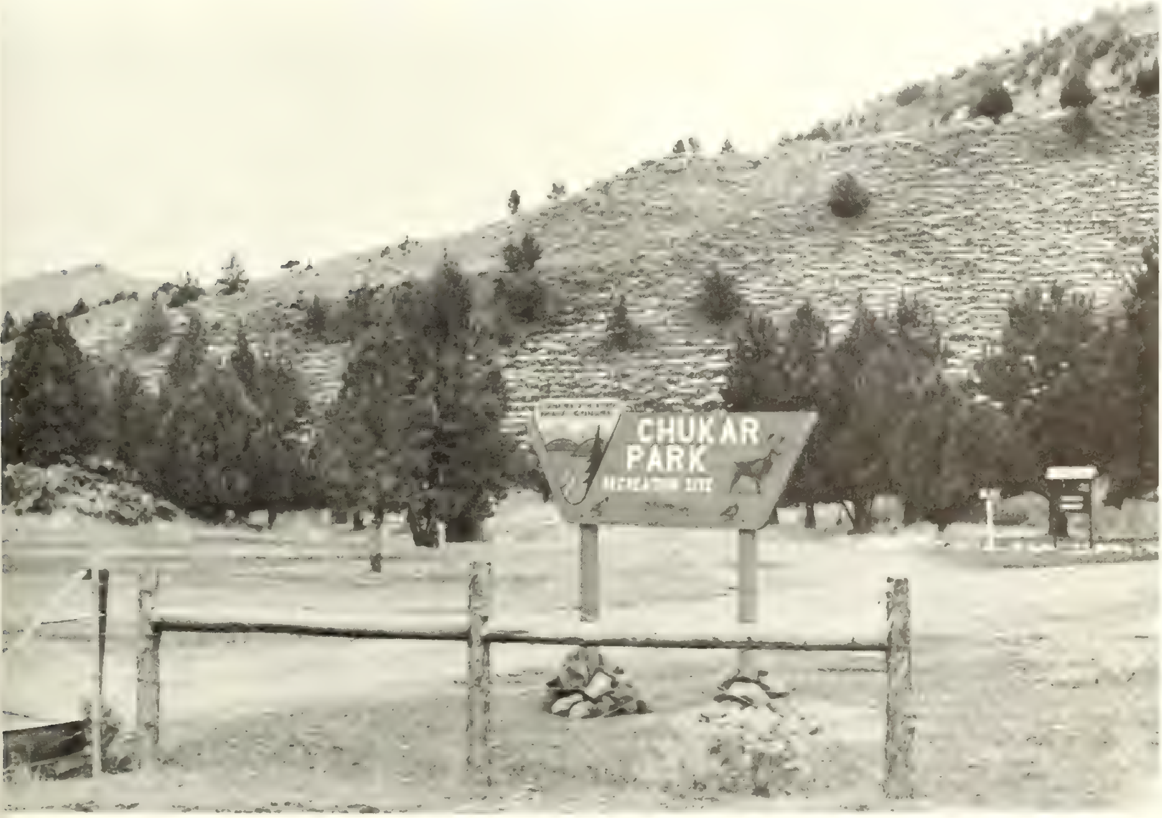
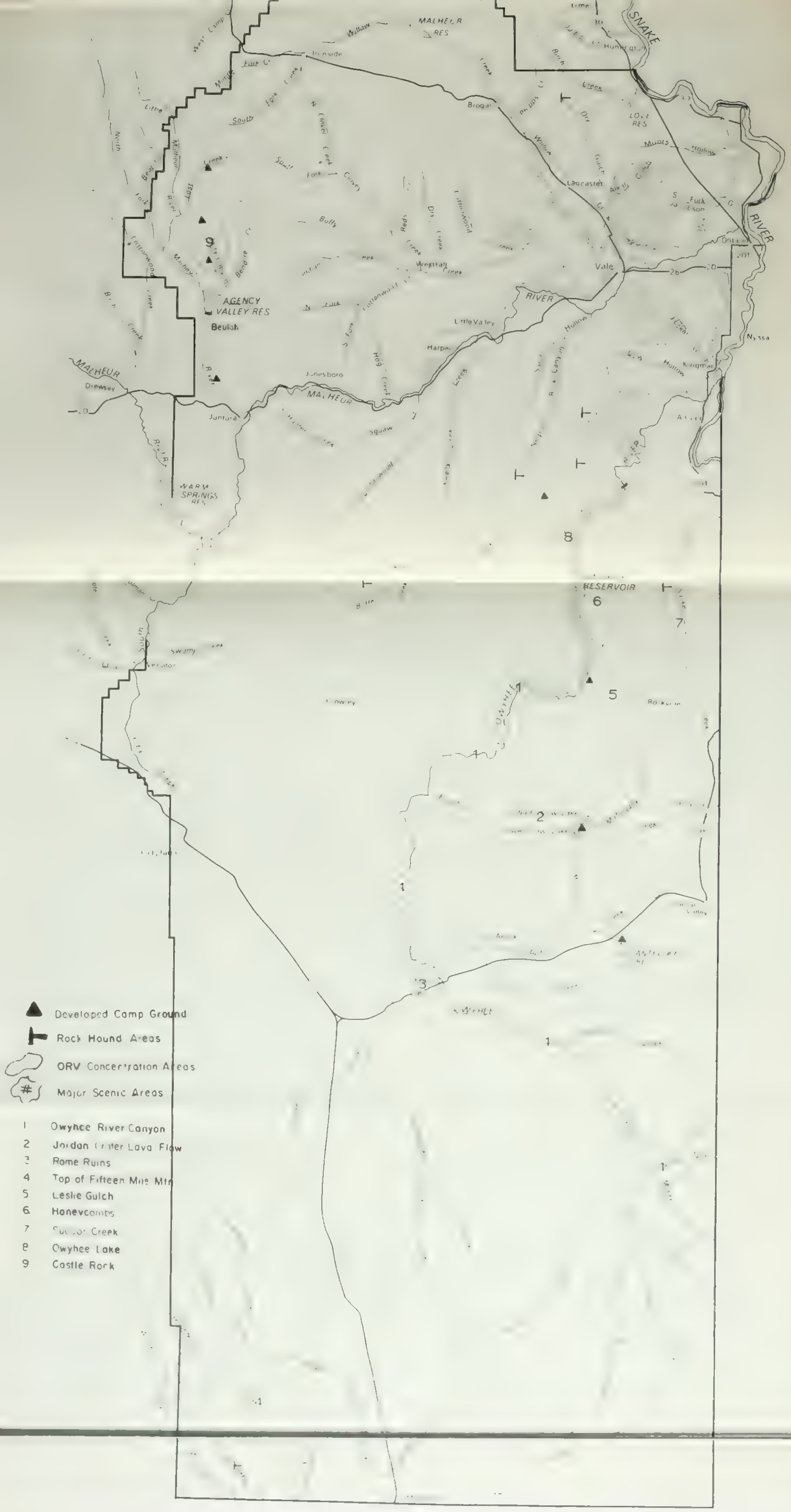


Figure 59.--Chukar Park illustrates a well-developed and posted recreation site (Bureau of Land Management photo).

Developed Camp Ground
Rock Hound Areas
ORV Concentration Areas
#
Major Scenic Areas
1 Owyhee River Canyon
2 Jordan Crater Lava Flow
3 Rome Ruins
4 Top of Fifteen Mile Mtn
5 Leslie Gulch
6 Honeycombs
7 Succor Creek
8 Owyhee Lake
9 Castle Rock
SNAKE
RIVER
MALHEUR RES
Willow
Ironside
Brogan
Birch
Creek
Dry
LOVE RES
Moores Hollow
S Fork
Lancaster
Alkali Gulch
Vale
Ontario
Nyssa
20
26
RIVER
Little Valley
Harper
Jonesboro
MALHEUR
Juntura
Drewsey
MALHEUR
Hog Creek
Westfall
Cottonwood
Bully
Clover Creek
South Fork
Little
North
Lost
AGENCY VALLEY RES
Beulah
WARM SPRINGS RES
RESERVOIR
OWYHEE
Squaw
Hollow
Kingman
Swamp
Crowley
1
2
3
4
5
6
7
8
9

water and sanitation facilities presented more difficult problems than were expected. BLM pays costs of vandalism, maintenance, and garbage collections. The recreational public's user fees do not help defray those costs. Construction and maintenance of camping facilities have been changed to meet the needs of users as they were demanded, rather than in planned development in the hope of attracting users. For example, an accurate inventory of all the recreational facilities does not exist and we found no plans for short-range developments. Table 23 is incomplete.

Several conflicts between recreationists and other users resulted in major land use decisions for recreational benefits. The tendency for transients to leave gates open has resulted in construction of cattle guards. Stockmen rightly continue to complain about open gates. Cattle need to be eliminated from grazing and travelling through campgrounds, which requires fencing and cattle guards. The road system was expanded during the course of the program, giving recreationists greater access to hunting areas and other facilities; it also gives motorized cattle rustlers greater access. Increasing recreational use results in more wildfires which cost ranchers the forage and BLM the firefighting efforts. We find these problems to be relatively minor and that modifications in fencing and in pattern of grazing cause few difficulties. Stockmen, however, find vandalism on water, fences, and livestock to be a problem, but their complaint is against people, not necessarily recreationists.

Overall, the Vale District Program has benefited recreational users directly through increased roads and reservoirs, and indirectly through better wildlife habitats. Grazing use by livestock places few restrictions on recreationists. On the other hand, recreationists need to be more responsible than they now are.

NATIONAL HERITAGE

Numerous items, located on public and private land in the Vale District and characterizing national history, should receive increased attention. Historical sites, such as the Oregon Trail from the mouth of the Boise River into Snake River through Vale to Farewell Bend of Snake River; Meek's Cutoff following the Malheur River west from Vale; the Boise-Jordan Valley-Winnemucca stage route; and the Oregon Central Military Road westward from Jordan Valley to the Rome Crossing and Camp Smith attracted people during 1976 but not many in other years. Old houses, stage stations, graves, and the like along these routes warrant an inventory and preservation. These trails should have signs for all to see and remember.

The archeological heritage in the Vale District has never been surveyed. Examinations in 1976 along the lower Owyhee River disclosed many unknown sites of former Indian occupations. Excavations in the Dirty Shame Rock Shelter southwest of the three forks of the Owyhee River uncovered artifacts of very early civilizations in the Western United States. The Vale District is a rich and promising area for further archeological exploration.

The range rehabilitation projects before 1969 did little to protect archeological values and may have inadvertently destroyed or damaged a few sites. Springs attracted early American man, as they do his counterpart today. Livestock, trails, and roads followed the routes from one water project to the next. Therefore, spring developments and reservoirs may have covered, destroyed, or damaged important sites. Onsite archeological examinations before treatments began about 1969. Archeological values must continue to be considered in locating range improvements. The Vale Program was finished before these national heritage values became great public issues; so now an intensive and immediate survey is needed to prevent further losses.

OCCUPANCY

Much less pressure exists in the Vale District than in other regions to allow building of houses, hotels, restaurants, and other structures for use by recreationists and by those who want a summer or retirement home. Coincident with increased recreational usage, more and more permits will be requested to build accommodating structures for them. This appears to be an issue related to the rangeland rehabilitation program only to the minor extent that it has increased recreational use.

MINING

Mineral resources on the Vale District do not contribute significantly to the local economy nor greatly influence other users. Historically, gold has been mined in Malheur County near Jordan Valley and the historic town of Malheur City, silver mining occurred in adjacent counties, and mercury deposits have been sporadically exploited. Small operations mine sand, gravel, and building stone. Geothermal power leases now suggest a potential resource. Currently, diatomite is mined near the town of Westfall with a significant impact on nearby vegetation. The existing mining laws permit removal of a large hill of diatomite located in the Bully Creek seeding. Mine spoil materials cover many acres, making the adjacent seeding only half usable (fig. 61). Rehabilitation of this site will be difficult.

WATERSHED

Lack of water of good quality limits agricultural and industrial development in the Vale District. Earlier sections of this report described the climate and effects of water on livestock distribution. The livestock industry and agriculture in Malheur County use water, amounting to about one-half million acre feet (617 million m^3) annually for irrigating pastures, haylands, and crops.

Precipitation limits average annual runoff from the Vale District to an estimated 114,425 acre feet (133 million m^3) (Bureau of Land Management 1974). Yearly amounts flowing down Bully Creek, 1,000-40,000 acre feet (1.2-4.9 million m^3) illustrate the high variability of the runoff. About 75 percent of the irrigation water used in the district comes from the Snake River. Not all irrigable lands in the district have sufficient water and no additional land appears to be susceptible to economic development. Municipal and industrial water is adequate.

Fewer than 250 parts per million (p/m) of dissolved solids occur in the upper Malheur River water. Near Willow Creek east of Vale, and in some of the poorest range in the district, the sediment concentrations vary from 1,000 to 5,000 p/m. Highly alkaline soils occur, contributing to an apparent erosion problem. Jordan Creek has increased sediments during the season of high runoff.

Erosion and its control formed a major thrust of the Vale Program. Although baseline sediments in streams and erosion due to natural processes are unknown, erosion was a problem before the program started.

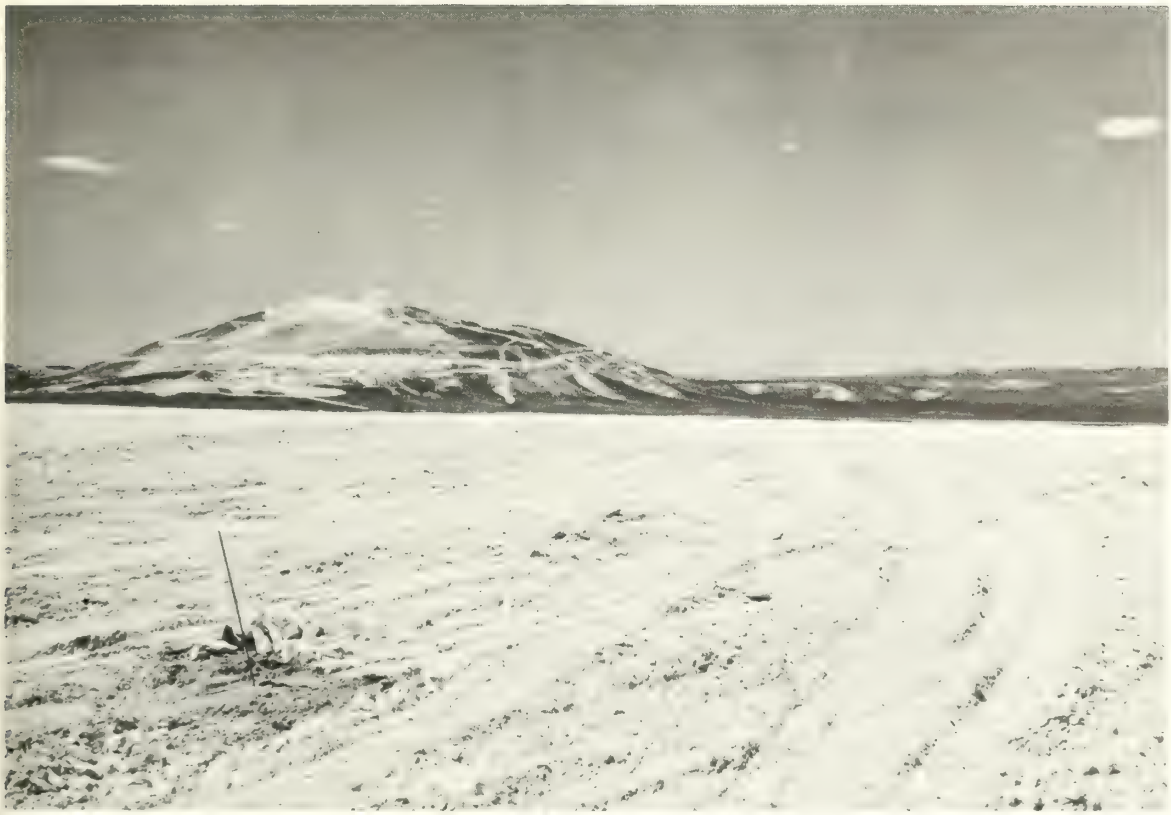


Figure 61.--Strip mining for diatomite will eliminate the hill in the background. The spoil covers a seeding of crested wheatgrass in the foreground.

Soil surface conditions provide the first line of defense against excessive runoff and erosion. Live vegetation and litter retard runoff and increase infiltration. Less of the water that enters the soil is lost by evaporation and more used by plants, appears in springs, or filters to the groundwater when the soil is covered. The extent to which the Vale District Program reduced erosion and changed the pattern of water discharge through increased soil cover should be evident in altered flows of the Malheur and Owyhee Rivers, in less sedimentation of streambeds, healing of gullies, and less sheet erosion. The only flow data available, to our knowledge, comes from regular water measurements in the Malheur and Owyhee Rivers. The highly variable nature of the flows masks any changes in flow that might be due to the rehabilitation program.

Only local areas, for example, Sand Hollow with unstable soil and a naturally high erosion rate, still have active gully formation. Nearly all the district shows evidence of past erosion. Gullies healing with sagebrush and perennial grass in the bottoms are common (fig. 62). No documentary evidence of decreased sediment input into the Snake and Owyhee Rivers could be found, but such a reduction certainly exists because of the healing gullies.

The Jordan Valley plot referred to previously, where nearly all grazing has been excluded for 40 years, serves as a benchmark for the evaluation of the interaction of grazing and sheet erosion. No significant erosion occurs either inside or outside the fence, the plants tend to be pedestalled in the exclosure, but this is due to the natural accumulation of organic matter within the plant bases and not to erosion.

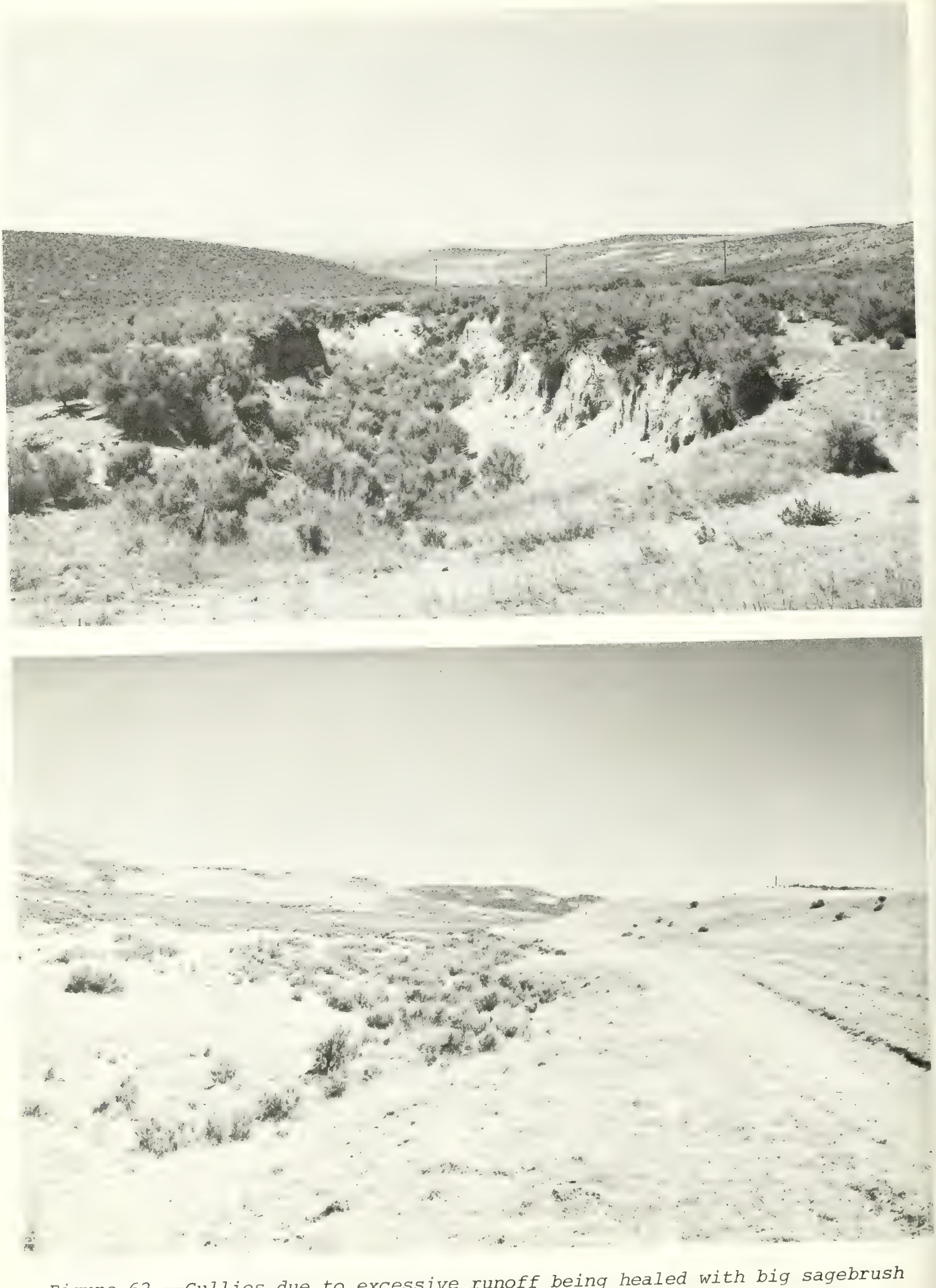


Figure 62.--Gullies due to excessive runoff being healed with big sagebrush and grasses. Note that the road in lower photo shows little evidence of erosion.

The district soils appeared well stabilized in 1975. Halting of excessive erosion, as a first priority in the Vale District Program, has been accomplished over a vast majority of the district lands. This benefit to the life of the reservoirs, to the aquatic life, to the quality of water, and to all downstream users of water, although unmeasurable in dollars, has great value. Recreational vehicles may cause as much soil damage and erosion as any other use (fig. 63).

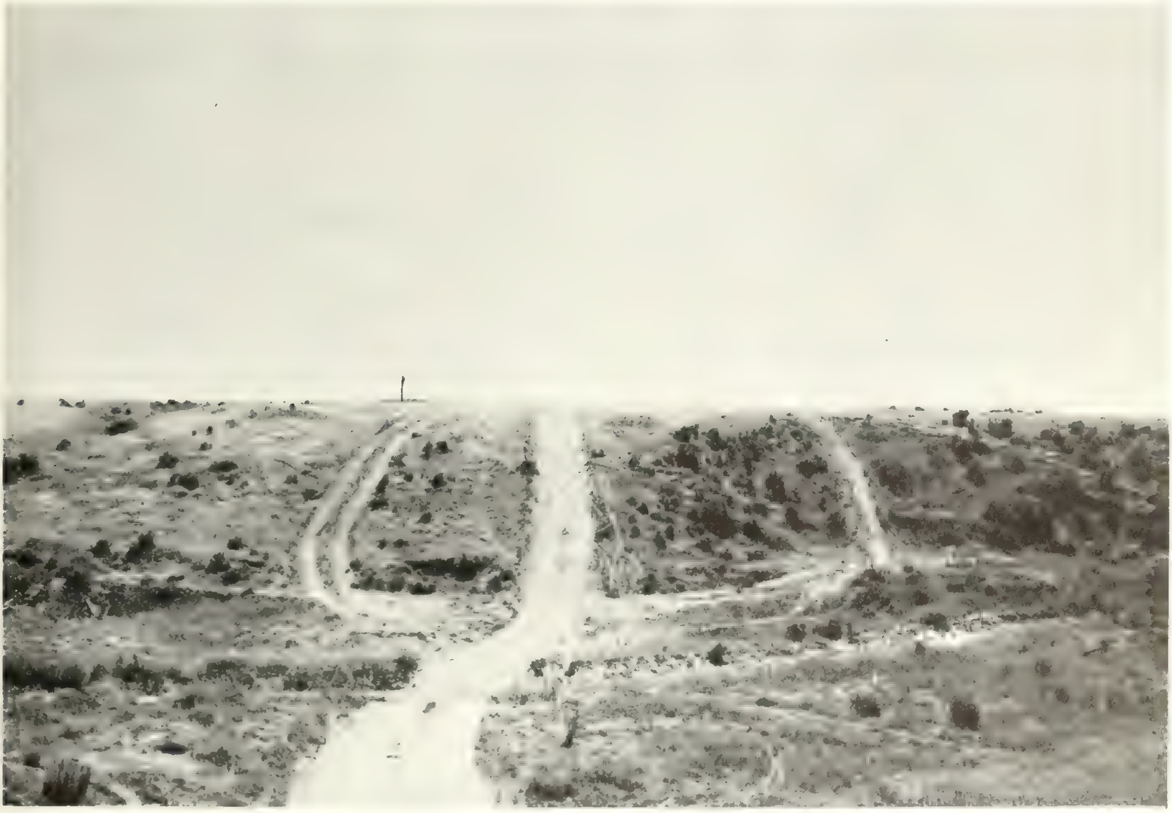


Figure 63.--Damage to soil and vegetation caused by recreational vehicles.

Costs and Benefits of the Vale District Program

The Vale Program presents a remarkably complex set of problems in economic analysis which, with the exception of strictly forest uses, encompass most situations encountered in evaluating the multiple uses of natural resources. Grazing by livestock dominates the economic and multiple use nature of the program.

The question "Was the Vale Program a cost effective investment of Federal funds?" does not yield to simple analysis. Two Ph. D. dissertations have considered livestock production and use of forage for a few years and on only a portion of the district (Nielsen 1965, Godfrey 1971). Other publications (Nielsen et al. 1966; Stevens and Godfrey 1972, 1976) also discuss the economics of rangeland rehabilitation on the Vale District for livestock production.

Stevens and Godfrey (1976) in their analysis of the economics of the Vale Program included only 20 of the 147 allotments for the period 1960-69. Data from individual projects were readily available for that timespan and those areas. They found rehabilitation costs per acre to be $4.57 ($11.29/ha) for spraying, $7.59 ($18.75/ha) for spraying and seeding, and $12.96 ($32/ha) for plowing and seeding. Improvements on native range cost $0.32/acre ($0.79/ha) (table 24). Per acre (0.405 ha) costs varied for several reasons. The period 1960-69 covered nationwide fluctuations in price levels. Costs were functions of project size, and travel or other difficulties resulted in a few projects having extremely high costs. The incomplete data available for the entire program and for most specific projects suggest that Stevens and Godfrey selected the most accurate data obtainable.

Table 24--*Average costs of range improvements per acre*[1] *on 20 Vale District, Bureau of Land Management, allotments between 1960 and 1969*[2]

Improvement	Spraying	Spraying and seeding	Plowing and seeding	Native range
		Dollars		
Rehabilitation	2.23	4.69	8.56	--
Fencing and cattle guards	.95	1.20	2.03	0.16
Water development	.57	1.16	1.76	.14
Other	.82	.53	.61	.01
Total	4.57	7.58	12.96	.33

[1] 1 acre equals 0.405 hectare.

[2] From Stevens and Godfrey (1976).

Many economic analyses remain undone. We will not attempt a detailed cost/benefit analysis of specific practices and benefits within the Vale Program. That has been started by others, and it deserves separate funding and more attention than we can give it. We take an overview by attempting to evaluate the importance of several economic factors by drawing attention to areas needing further study and by advancing results which are pertinent to the question above on cost effectiveness of the whole district program. Benefit/cost analyses of the separate projects and of the separate management practices should be done to facilitate further study into interactions, trade-offs, and decisionmaking.

Three inherent rangeland conditions and the assumptions based on them alter the analysis of benefits and costs. First, the benefits accruing from a project do not depend on independent production functions; for example, forage removal by livestock affects subsequent forage productivity. Forage production increased on untreated pastures because of the additional use made of the treated areas. The native pastures also improved in response to enlightened management of livestock without the introduction of treated areas or without capital investments in rehabilitation practices. Since only 10 percent of the Federal rangeland in the district received any kind of land treatment, an increase in potential productivity of the whole district appears slight. The main result of the Vale Program could have been to speed the rate of recovery, not the extent of it. Stevens and Godfrey (1976) attempted to deal with this problem in their simple model to explain the interdependency of pasture treatments.

A second assumption or condition is that the Vale Program was conceived, justified, and established as a coordinated set of practices for increasing forage production over the entire district. For example, a proposed project in the north may not have been on as favorable a site as one in the south; yet the northern site was selected to spread the benefits throughout the district. Thus, cost/benefit analysis of an individual project may not truly indicate its worth within the whole program. This point is especially important because livestock may be shifted from one part of the district to another.

Third, the results from the whole district program form the basis of analysis--just as a whole ranch operation must be used to determine ranch profits. A benefit/cost analysis of a range practice on Federal land may be used in a study of both a ranch business and the district program. The conclusion reached in the two situations may be completely different because the benefits occur in two different systems; for example, the benefits of water development on the Federal land have different values in the contexts of ranch and district. One does not measure the other.

Our estimate of the effectiveness of the Vale Program as an investment of public funds used a simple economic analysis--we estimated and compared cost effectiveness under alternative management plans (fig. 64).

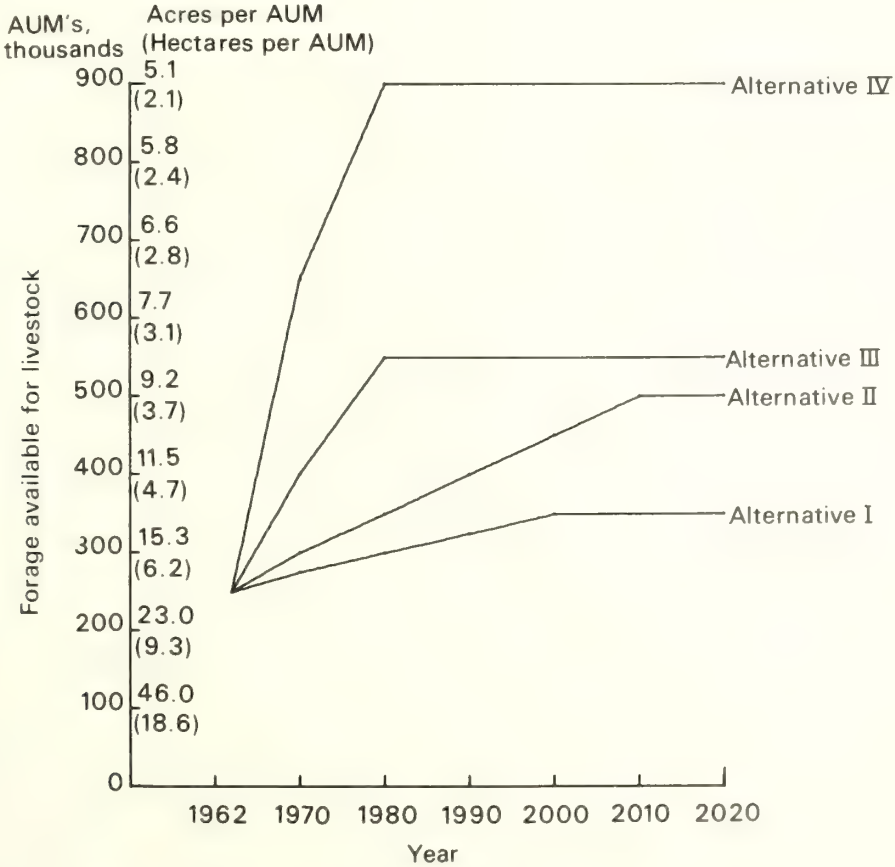


Figure 64.--Forage available for livestock under alternative management programs.

Estimation of forage production (Aum's) on the Vale District has been and will continue to be a largely subjective exercise. Before each project commenced, an estimate of grazing capacity was made by experienced field personnel. BLM annually estimates forage production (table 12) by adding estimated AUM's for individual allotments. Each allotment capacity, in 1975 for example, was the actual use (AUM's) adjusted upward or downward by the number of AUM's that would attain proper use. Management objectives and annual variability in production influence the objectives. Figure 65 gives estimated grazing capacity in acres per AUM for various treatments, untreated areas, and the Vale District as a whole.

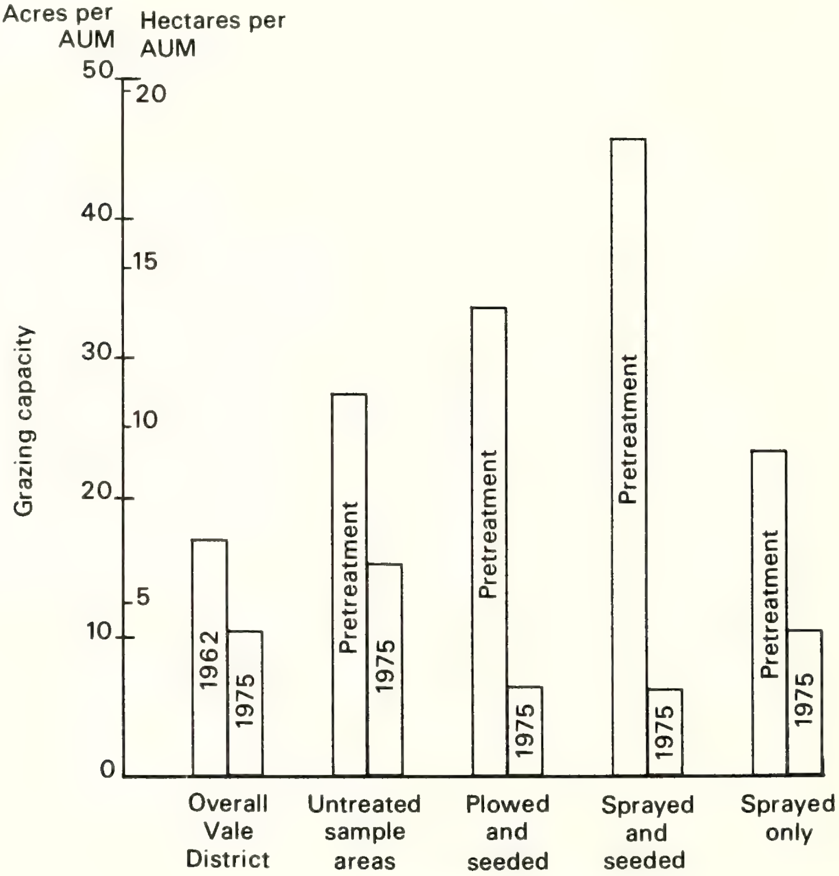


Figure 65.--Estimated grazing capacity before and after various land treatments.

These data form the basis for the estimates of potential grazing capacity under the four alternative management plans (fig. 64).

Alternative I defines recommendations by BLM as objected to by lessees before the Vale Program started. This alternative provided the incentive for the Vale Program. Proper range use was to be attained solely by limitations on grazing permits. Presumably the range would slowly improve. AUM's would remain low for many years. Alternative II was initially the same as Alternative I, with the important addition of water developments and fencing to attain better animal distribution. Alternative III is our estimate of the effects of the Vale Program.

Alternative IV estimated the results of the Vale Program as first proposed if it had been completed in its original form. Alternative IV probably was overly optimistic even if full funding had been available. Table 25 gives estimated costs and benefits of the four alternative levels of management. All values are discounted at a 5-percent rate to a 1962 constant year.

Table 25--*Forage values, improvement and maintenance costs, and benefit/cost ratios for 4 alternative management levels*

Item	Alternative I	Alternative II	Alternative III	Alternative IV
		Million dollars		
Forage value discounted to 1962:				
$3.00/AUM	17.6	20.5	26.2	39.4
$1.51/AUM	8.8	10.25	13.1	19.7
Improvement costs discounted to 1962	0	1.4	7.0	13.0
Maintenance costs discounted to 1962	0	2.2	2.2	2.2
Total cost discounted to 1962	0	3.6	9.2	15.2
Dollar value of forage increase:				
$3.00/AUM	0	2.9	8.6	21.8
$1.51/AUM	0	1.45	4.3	10.9
Benefit/cost:				
$3.00/AUM	--	.8	.9	1.4
$1.51/AUM	--	.4	.5	.7

During the course of the Vale Program, many different amounts have been given for the cost. The amount budgeted was to have been $12,392,280 for land treatment, $2,019,080 for administration, and a third amount for miscellaneous expenses, resulting in a total of $16,230,460 (Bureau of Land Management [n.d.]). Yet the text of the proposal states $12,392,280 as the total cost of the rehabilitation program but $7,775,000 was added to that for roads and recreational development. This is the probable source of the statements that the Vale Program cost $20 million. Fulcher (1975) correctly called the Vale Program a proposed $16.5 million project. The value of $16,230,000 spent over 7 years discounted to 1962 at 5 percent is $13.0 million (table 25).

The money actually spent is not known because a separate accounting for the Vale Program was never made. Then new money was added onto the regular operating budget for the district giving a total of $11.6 million for range conservation for 1962-73 (table 10). BLM personnel did not separately account for time spent on either normal or Vale Program activity. Thus, only a rough estimate of the Vale Program expenditures can be made. Improvement practices themselves were funded elsewhere, as noted in table 10, and all BLM districts received about $200,000 per year for 1963-73. Therefore, a base program budget has been deducted from the total Vale appropriations for a better estimate on new money. Administrative and maintenance costs are more elusive, and some persons question whether or not the Vale Program contributed significantly to administrative costs. The original proposal contained an item of $288,000 per year for administration and supervision. Discounted expenditures were $7 million without administrative and maintenance costs, or $9.2 million including maintenance and administration (table 25).

Costs to the Government were not covered by grazing fees of $0.30/AUM in 1963, which increased to $1.51 in 1976 (table 26). An AUM, the amount of forage needed to maintain one mature cow with calf or its equivalent for 1 month, was worth more than the fee charged by BLM. The real worth depends on the efficiency of the individual operator, costs of alternative sources of forage, livestock prices, seasonal forage availability, and forage quality. An underevaluation of forage on Federal lands is reflected by existence of a capitalized value when the grazing permit is attached to private property. Such properties sell for a higher price than comparable land without Federal permits. Land assessors in the Vale area estimated the capitalized value of a permit at $25/AUM in 1975. A study by BLM (Rumpel 1974) showed that an AUM on private land was worth $5. Stevens and Godfrey (1976) estimated leased forage to cost about $3/AUM during the period 1960-69. A standard appraisal technique prices a Federal AUM at 60 percent of a private AUM because of increased uncertainty and costs of grazing of public lands. This study uses $3 as the market value for a Federal AUM on the Vale District (table 25).

Table 26--*Fees for grazing on the Vale District, Bureau of Land Management, 1960-76*

Grazing year	Dollars per animal unit month	Grazing year	Dollars per animal unit month
1960	0.22	1969	0.44
1961	.19	1970	.44
1962	.19	1971	.64
1963	.30	1972	.66
1964	.30	1973	.78
1965	.30	1974	1.00
1966	.33	1975	1.00
1967	.33	1976	1.51
1968	.33		

At $3/AUM the Vale Program, although it was not designed to be a cost-effective investment, appears to have been a sound investment of Federal funds with a benefit/cost ratio close to unity even including administrative costs (alternative III, table 25).

All three alternative levels of improvement would have given benefit/cost ratios greater than 1 at $3/AUM except for the high cost of maintenance. Most maintenance costs are incurred in monitoring and maintaining water developments. Since the three levels of improvement, II, III, and IV, include the same amount of water development, a continued yearly cost of $200,000 was assumed for each or discounted to 1962 prices at $2.2 million.

Alternatives I and II, the lower levels of management, were politically unacceptable and ecologically questionable because of the long predicted time for vegetational changes. Alternative IV, we believe, would have been cost effective. At $1.51/AUM, the present grazing fee, no level of management returns the money that BLM spent on rehabilitation (table 25).

Thus far, this discussion of benefits and costs is based on forage values for livestock. Other users also benefited from the vegetational rehabilitation in the Vale Program. If one considers the AUM price at $3, the other benefits cost only about $600,000. If the $1.51 price is used, the other benefits cost $5 million (table 25, alternative III), which seems to us to be a low price for the highly vigorous condition of animals and plants, and a countryside with little serious erosion compared with greatly deteriorated conditions 15 years ago. We find that the wise use of public funds in the Vale Program produced exceptional results that are sound both biologically and economically. It is a truly remarkable result for a first attempt on so large an area and great expenditure. Under the existing systems of management, the range continues to improve (fig. 66). The flexibility and alternatives in management continue to widen.

Public Opinion

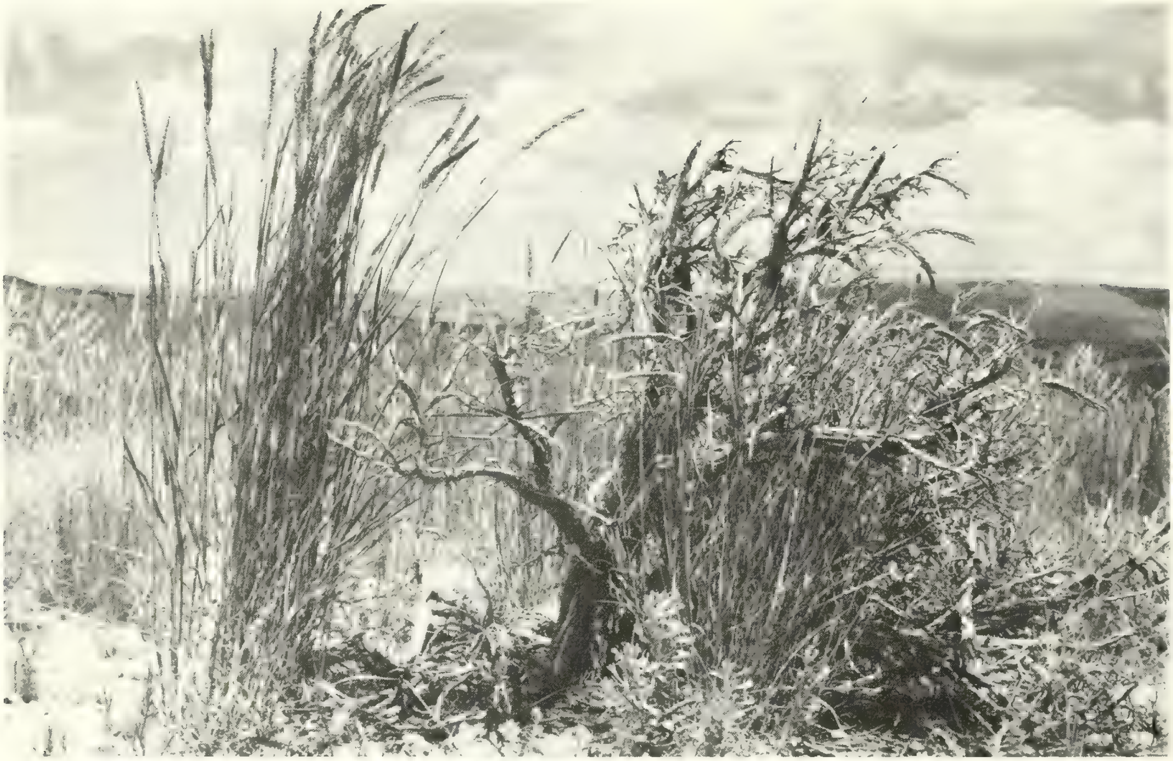
Public opinion supported the Vale Program in its beginning, as shown early in this report, but not without some dissent. Little doubt ever existed that the proposed program would help the community. Skeptics argued against the mixtures of project treatments and doubted the ability of BLM to finish the job without massive errors. After all, a program of such a large scale had never been attempted. Crested wheatgrass was a relative newcomer to the district; and cheatgrass, despite all its problems of variable production and poor palatability, at least was a familiar forage resource. The business community generally supported the proposal, but the ranching group was doubtful.

The Ontario Democratic Club, reflecting the ranching community in Malheur County, drafted a letter to the congressional sponsors of the appropriation expressing concern that many acres (hectares) of crested wheatgrass were to be planted to the exclusion of the proven forage producer, cheatgrass. The letter urged that the major thrust of the Vale Program should be to provide additional water developments. The criticisms led the local congressional leaders to insist that land treatment start immediately. Continued funding of the Vale Program may well have hinged on early demonstrations of successful conversion of big sagebrush to grassland.

Public reaction to Federal regulation of use on the free range evolved from resentment, through legal attempts to reduce the authority of BLM, to resigned acceptance, and recently, to a spirit of cooperation. The majority of livestock producers in the Vale District no longer consider BLM an adversary. Abundance of grass aids this relationship. However well accepted the overall rehabilitation program, everyone finds fault with some aspect of Federal regulation.

We sampled public opinions on the current program and asked specifically about future concerns. Our sample is impressionistic and not quantitative because most of the information came from casual conversations with people and from newspaper accounts, letters, and BLM records. Eight formal interviews were held with people having a wide variety of interests. Individual reaction cannot be given so our comments aim for interpretation of general public reactions.

The BLM did an excellent job in selling the Vale Program. Tours with the Advisory Board, user groups, and range management professionals contributed to knowledge of the BLM efforts and to a feeling of participation by the community. Dissemination of information continues, and the program is still regarded as a success. Critical opinion exists, however, in certain areas.



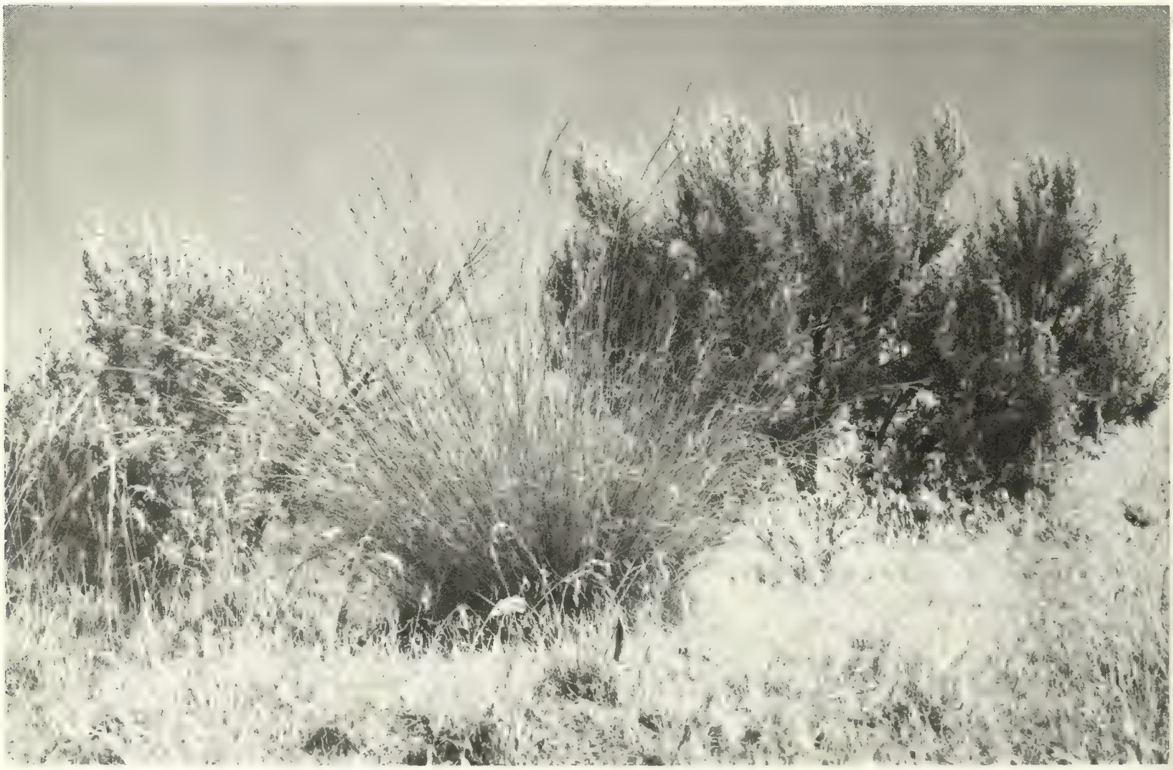


Figure 66.--Top, crested wheatgrass and a dead big sagebrush plant (Bureau of Land Management photo). Bottom, bluebunch wheatgrass plant and big sagebrush illustrate range conditions on most of the Vale District.

Dissent centers around lack of forage to satisfy obligated demand in the northern resource area, especially around Vale and Ontario. Cheatgrass still persists over thousands of acres and some reseedings of crested wheatgrass have failed. Abundant forage in the southern area brings forth suggestions from the north for reallocation of use permits. Regions with land treatment failures are reservoirs of adverse opinion.

A second area of concern lies in increasing demands from recreationists and wildlife advocates for less grazing by domestic animals and more attention to their own interests. When BLM accedes to these pressures, relationships with the livestock interests become strained. Stockmen claim that attitudes toward wild horses go beyond biological reasonableness and that current court decisions on environmental impact statements restrict rangeland rehabilitation and food production more than they should. Livestock people recognize that poor practices were largely to blame for 75 to 100 years of range deterioration but they point with pride and take part of the credit for much range improvement in recent years, which they claim that other user groups refuse to recognize. Pressures by those groups for land formerly believed not useful for anything but livestock grazing will continue and were recognized by all. The livestock interests have become skeptical of continued BLM support; yet they know that interests other than for livestock will play an increasing role in the land use of the Vale District. BLM has recognized this fact in the Advisory Board which now has members representing several user interests. Balance among these groups will become increasingly difficult to attain. We note that environmentalists' and protectionists' views about the Vale District from outside are more intense than those from within the district.

Plant Names

Nomenclature for common and scientific plant names used in the text follows Hitchcock and Cronquist (1973).

Common name	Scientific name
Alfalfa, Nomad	*Medicago sativa*
Bitterbrush, antelope	*Purshia tridentata*
Bluegrass, Sandberg	*Poa secunda*
Cheatgrass	*Bromus tectorum*
Cherry, wild	*Prunus* spp.
Clover, strawberry	*Trifolium fragiferum*
Clover	*Trifolium* spp.
Cottonwood, black	*Populus trichocarpa*
Fescue, Idaho	*Festuca idahoensis*
Greasewood, black	*Sarcobatus vermiculatus*
Halogeton	*Halogeton glomeratus*
Hawthorn	*Crataegus* spp.
Hopsage, spiny	*Grayia spinosa*
Indian ricegrass	*Oryzopsis hymenoides*
Junegrass, prairie	*Koeleria cristata*
Juniper, western	*Juniperus occidentalis*
Larkspur	*Delphinium* spp.
Mountain-mahogany	*Cercocarpus ledifolius*
Mustard	*Brassica* spp. and *Sisymbrium* spp.
Needlegrass	*Stipa* spp.
Needlegrass, Thurber	*Stipa thurberiana*
Needle-and-grass	*Stipa comata*
Pine, ponderosa	*Pinus ponderosa*
Rabbitbrush	*Chrysothamnus* spp.
Sweetclover, yellow	*Melilotus officinalis*
Sage, bud	*Artemisia spinescens*
Sagebrush, big	*Artemisia tridentata*
Sagebrush, low	*Artemisia arbuscula*
Shadscale	*Artiplex confertifolia*
Squirreltail	*Sitanion hystrix*
Thistle, Russian	*Salsola kali*
Wheatgrass, bluebunch	*Agropyron spicatum*
Wheatgrass, crested	*Agropyron cristatum* and *Agropyron desertorum*
Wheatgrass, fairway crested	*Agropyron cristatum*
Wheatgrass, pubescent	*Agropyron trichophorum*
Wheatgrass, standard crested	*Agropyron desertorum*
Wheatgrass, tall	*Agropyron elongatum*
Wheatgrass, western	*Agropyron smithii*
Wildrye, giant	*Elymus cinereus*
Willow	*Salix* spp.

Published and Unpublished References

Bureau of Land Management. 1974. Malheur County economic profile. Vale Dist. 28 p.

Bureau of Land Management. [n.d.] The Vale Project: A 7 year program for sustained yield natural resource management. Oreg. State Office. 43 p. (Mimeogr.)

Cline, G. G. 1974. Peter Skene Ogden and the Hudson's Bay Company. 279 p. Univ. Okla. Press, Norman.

Daubenmire, R. 1970. Steppe vegetation of Washington. Wash. Agric. Exp. Stn. Tech. Bull. 62, 131 p.

Davies, K. G., A. M. Johnson, and D. O. Johnson. 1961. Peter Skene Ogden's snake country journal, 1826-27. 255 p. Hudson's Bay Rec. Soc., London.

Dyrness, C. T., Jerry F. Franklin, Cris Maser, and others. 1975. Research natural area needs in the Pacific Northwest. USDA For. Serv. Gen. Tech. Rep. PNW-38, 231 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Foss, P. O. 1960. Politics and grass: The administration of grazing on the public domain. 236 p. Univ. Wash. Press, Seattle.

Franklin, Jerry F., and C. T. Dyrness. 1969. Vegetation of Oregon and Washington. USDA For. Serv. Res. Pap. PNW-80, 216 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Franklin, Jerry F., and C. T. Dyrness. 1973. Natural vegetation of Oregon and Washington. USDA For. Serv. Gen. Tech. Rep. PNW-8, 417 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Fulcher, G. D. 1964. Vale evaluation report. Unpubl. rep. 15 p.

Fulcher, G. D. 1975. Resource development on a grazing district. *In* Forest resource management. W. A. Duerr, D. E. Teeguarden, S. Guttenberg, and N. B. Christiansen (eds.). Chapter 48, p. 1-8.

Godfrey, E. B. 1971. An economic evaluation of range improvements administered by the Bureau of Land Management in the Vale District of Oregon. 147 p. Ph. D. Diss., Oreg. State Univ., Corvallis.

Griffiths, David. 1902. Forage conditions of the northern border of the Great Basin. Bur. Plant Ind. Bull. 15, 60 p.

Hanley, M., and E. Lucia. 1974. Owyhee trails: the West's forgotten corner. 314 p. Caxton Printers, Ltd., Caldwell, Idaho.

Harris, G. A. 1967. Some competitive relationships between *Agropyron spicatum* and *Bromus tectorum*. Ecol. Monogr. 37:89-111.

Hitchcock, C. L., and A. Cronquist. 1973. Flora of the Pacific Northwest. 730 p. Univ. Wash. Press, Seattle.

Hyder, D. N., and F. A. Sneva. 1955. Effect of form and rate of active ingredient, spraying season, solution volume, and type of solvent on mortality of big sagebrush, *Artemisia tridentata.* Oreg. Agric. Exp. Stn. Tech. Bull. 35., 16 p.

Irons, K. E. 1964. Final report--Lodge and Top aerial brush spray project. Contract No. 14-11-000-1-2562. Letter dated Dec. 22, 1964, 5 p.

Jackman, E. R., and R. A. Long. 1964. The Oregon desert. 407 p. Caxton Printers, Caldwell, Idaho.

Kindschy, R. R. 1971. The Vale project and wildlife ecology. Bur. Land Manage. Rep. 27 p. (Mimeogr.)

Kindschy, R. R. 1972. Untitled summary of wildlife population sizes in the Vale District. Bur. Land Manage. 4 p. (Mimeogr.)

Kittleman, L. R. 1973. Guide to the geology of the Owyhee region of Oregon. Mus. Nat. Hist. Univ. Oreg. Bull. No. 21, 61 p.

Lovell, B. B., M. G. Norgren, D. W. Anderson, and G. H. Simonson. 1969. Owyhee drainage basin general soil map report with irrigable areas. 72 p. Oreg. State Agric. Exp. Stn. and State Water Resour. Board.

Nielsen, D. B. 1965. Economics of Federal range use and improvement. 165 p. Ph. D. Diss., Oreg. State Univ., Corvallis.

Nielsen, D. B., W. G. Brown, D. H. Gates, and T. R. Bunch. 1966. Economics of Federal range use and improvement for livestock production. Oreg. Agric. Exp. Stn. Bull. 92, 40 p.

Oliphant, J. O. 1968. On the cattle ranges of the Oregon Country. 372 p. Univ. Wash. Press, Seattle.

Oregon State Game Commission. 1963-74. Annual reports.

Piemeisel, R. L. 1938. Changes in weedy plant cover on cleared sagebrush land and their probable causes. U.S. Dep. Agric. Tech. Bull. 654.

Piemeisel, R. L. 1951. Causes affecting change and rate of change in a vegetation of annuals in Idaho. Ecology 32:53-72.

Preston, R. N. 1970. Historical maps of Oregon. 34 p. Treasure Chest Maps, Corvallis, Oreg.

Reeher, J. A. 1969. The effect of large scale livestock range rehabilitation on game species. Oreg. State Game Comm. Rep. 46 p. (Mimeogr.)

Rumpel, P. R. 1974. Master appraisal for commercial forage value. Unpubl. manuscr. 13 p.

Smithsonian Institution. 1974. Report on endangered and threatened plant species of the United States. 200 p. Smithson. Inst., Washington, D.C.

Stevens, J. B., and E. B. Godfrey. 1972. Use rates, resource flows, and efficiency of public investment in range improvements. Am. J. Agric. Econ. (Nov.) p. 611-621.

Stevens, J. B., and E. B. Godfrey. 1976. An economic analysis of public range investments on the Vale project, 1960-1969. Agric. Exp. Stn., Oreg. State Univ. Circ. Inf. 653, 18 p.

Stewart, G., and A. C. Hull. 1949. Cheatgrass (*Bromus tectorum* L.)--an ecologic intruder in southern Idaho. Ecology 30:58-74.

Thomas, J. W., R. J. Miller, H. Black, J. E. Rodiek, and C. Maser. 1976. Guidelines for maintaining and enhancing wildlife habitat in forest management in the Blue Mountains of Oregon and Washington. 41st North Am. Wildl. and Nat. Resour. Conf., Washington, D.C. 45 p. (Mimeogr.)

Uresk, D. W., J. F. Cline, and W. H. Rickard. 1976. Impact of wildlife on three perennial grasses of south-central Washington. J. Range Manage. 29:309-310.

Utah State Fish and Game Commission. 1948. Twenty-eighth biennial report. 80 p. State Utah.

U.S. Department of Agriculture, Forest Service. 1914. Notes on National Forest range plants; Part 1. Grasses. 224 p. Off. Grazing Stud.

Vale District Manager. 1974. Preliminary report on nomad alfalfa seedings, Vale District. 17 p. (Mimeogr.)

Vale, Thomas R. 1975. Presettlement vegetation in the sagebrush-grass area of the Intermountain West. J. Range Manage. 28:32-36.

Williams, G., D. E. Miller, and D. H. Miller. 1971. Peter Skene Ogden's snake country journals. 1827-28 and 1828-29. 201 p. Hudson's Bay Rec. Soc., London.

Heady, Harold F., and James Bartolome.
1977. The Vale rangeland rehabilitation program: The desert repaired in southeastern Oregon. USDA For. Serv. Resour. Bull. PNW-70, 139 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Discusses the initiation, execution, and outcome of an 11-year program of range rehabilitation on public domain lands in southeastern Oregon. Initiated primarily to benefit the livestock industry, the investment of $10 million in range improvements also profoundly affected other multiple uses. The analysis of this large and successful program should serve as a useful guide for monitoring other range programs.

KEYWORDS: Range management, range development, rehabilitation, revegetation, environment, economics (rangeland).

Heady, Harold F., and James Bartolome.
1977. The Vale rangeland rehabilitation program: The desert repaired in southeastern Oregon. USDA For. Serv. Resour. Bull. PNW-70, 139 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Discusses the initiation, execution, and outcome of an 11-year program of range rehabilitation on public domain lands in southeastern Oregon. Initiated primarily to benefit the livestock industry, the investment of $10 million in range improvements also profoundly affected other multiple other multiple uses. The analysis of this large and successful program should serve as a useful guide for monitoring other range programs.

KEYWORDS: Range management, range development, rehabilitation, revegetation, environment, economics (rangeland).

Heady, Harold F., and James Bartolome.
1977. The Vale rangeland rehabilitation program: The desert repaired in southeastern Oregon. USDA For. Serv. Resour. Bull. PNW-70, 139 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Discusses the initiation, execution, and outcome of an 11-year program of range rehabilitation on public domain lands in southeastern Oregon. Initiated primarily to benefit the livestock industry, the investment of $10 million in range improvements also profoundly affected other multiple other multiple uses. The analysis of this large and successful program should serve as a useful guide for monitoring other range programs.

KEYWORDS: Range management, range development, rehabilitation, revegetation, environment, economics (rangeland).

Heady, Harold F., and James Bartolome.
1977. The Vale rangeland rehabilitation program: The desert repaired in southeastern Oregon. USDA For. Serv. Resour. Bull. PNW-70, 139 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Discusses the initiation, execution, and outcome of an 11-year program of range rehabilitation on public domain lands in southeastern Oregon. Initiated primarily to benefit the livestock industry, the investment of $10 million in range improvements also profoundly affected other multiple other multiple uses. The analysis of this large and successful program should serve as a useful guide for monitoring other range programs.

KEYWORDS: Range management, range development, rehabilitation, revegetation, environment, economics (rangeland).

The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Developing and evaluating alternative methods and levels of resource management.
3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research are made available promptly. Project headquarters are at:

Fairbanks, Alaska
Juneau, Alaska
Bend, Oregon
Corvallis, Oregon
La Grande, Oregon
Portland, Oregon
Olympia, Washington
Seattle, Washington
Wenatchee, Washington

Mailing address: Pacific Northwest Forest and Range
Experiment Station
P.O. Box 3141
Portland, Oregon 97208

The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

The U.S. Department of Agriculture is an Equal Opportunity Employer. Applicants for all Department programs will be given equal consideration without regard to race, color, sex or national origin.

0: PNW-71

DA Forest Service
source Bulletin PNW-71

April 1977

1975 WASHINGTON TIMBER HARVEST

by

J. D. Lloyd, Jr., *Supervisory Forester*

In 1975, the Washington timber harvest declined for the 2d year to 6.2 billion oard feet, 10 percent below 1974, and the lowest level in 8 years. The decrease, ich occurred on almost all ownerships, amounted to 561 million board feet in estern Washington and 130 million board feet in eastern Washington.

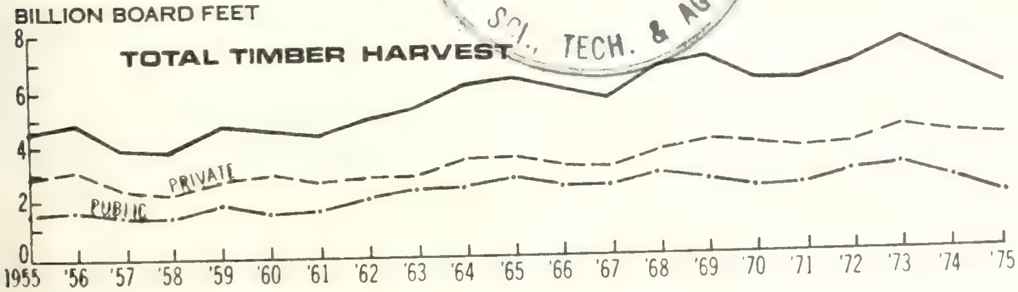
Harvest on private lands decreased 275 million board feet (5.0 percent) ompared with 1974. Industrial harvest increased 3 million board feet, but other rivate harvests decreased 278 million board feet (25 percent). Of the total arvest, 66 percent came from private lands--the greatest proportion since 1952.

Compared with 1974, harvest on all public lands decreased in western Washington by 331 million board feet (19 percent) and in eastern Washington by 85 million oard feet (11 percent). Harvest decreased on National Forests 191 million board eet (15 percent), on State lands 145 million board feet (21 percent), and on ndian lands 33 million board feet (7 percent). The remaining public agencies howed a combined decrease of 47 million board feet (42 percent).

Average stumpage prices on publicly owned or managed lands fell to their owest level in 3 years. Compared with the record high in 1974, the prices were 105.48 per thousand board feet (down $40.70) in western Washington and $43.52 er thousand board feet (down $29.98) in eastern Washington. Volume sold on these ands increased to 2.5 billion board feet (8 percent). Timber sold as small usiness set-aside sales on National Forests decreased to 312 million board feet 21 percent of all sales), down from the record high in 1974 of 358 million board feet (25 percent of total sales).

CLEMSON UNIVERSITY LIBRARY
FEB 6 1979
SCI., TECH. & AGR. DIV.

WASHINGTON TIMBER HARVEST 1955-75



PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION

orest Service
.S. Department of Agriculture

P.O. Box 3141
Portland, Oregon 97208

Timber harvest by ownership in the State of Washington, 1975[1]

(In thousand board feet, Scribner log scale)

Half-State and county	Private[2]						State[2]		Bureau of Land Management[4]		National Forests[4]		Indian lands[4]		Other public[2]		Other Federal[5]		Total production
	Industrial		Other		Total private														
	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	Live	Dead[3]	
Western Washington:																			
Clallam	173,615	2,528	36,602	826	210,217	3,354	72,727	2,831	--	--	18,665	16	17,662	584	600	--	177	--	326,833
Clark	4,036	--	15,652	5	19,688	5	6,342	235	--	--	--	--	--	--	-	--	--	--	26,270
Cowlitz	629,986	427	19,577	14	649,563	441	32,281	977	--	--	17,325	524	--	--	--	--	--	--	701,111
Grays Harbor	239,751	2,307	49,379	1,134	289,130	3,441	6,743	[illegible]	--	--	65,936	4,209	113,272	7,013	418	50	--	--	490,597
Island	5,170	--	13,413	--	18,583	--	280	--	--	--	--	--	--	--	--	--	200	--	19,063
Jefferson	95,799	3,938	47,328	828	143,127	4,766	199,701	6,437	--	--	19,523	51	6,666	196	429	200	555	--	381,626
King	225,199	555	144,334	35	369,533	590	25,629	303	--	--	30,864	2,506	--	--	4,579	80	1,057	--	435,141
Kitsap	8,197	--	16,798	--	24,995	--	1,132	67	--	--	--	--	1,037	561	773	--	135	--	28,700
Lewis	673,676	1,613	61,257	309	734,933	1,922	11,387	512	--	--	125,916	19,424	--	--	--	--	--	-	894,094
Mason	55,631	2,180	31,958	960	87,589	3,140	4,453	5	--	-	65,684	8,206	--	--	1,230	--	--	--	170,307
Pacific	383,464	3,826	8,635	30	392,099	3,856	10,091	200	--	--	-	--	--	--	576	--	--	--	406,822
Pierce	166,648	--	38,517	3,888	205,165	3,888	14,459	66	--	--	23,012	745	--	--	2,119	--	32,687	392	282,533
San Juan	--	--	13,326	--	13,326	--	--	--	--	--	--	--	--	--	--	--	--	--	13,326
Skagit	89,471	796	16,818	20	106,289	816	19,162	204	--	--	51,713	1,945	--	--	320	--	--	--	180,449
Skamania	22,301	18	31,559	238	53,860	256	5,961	48	--	--	171,198	12,865	--	--	161	--	--	--	244,349
Snohomish	79,036	28	76,952	3,230	155,933	3,258	25,194	7	--	--	49,627	2,597	588	336	308	--	--	--	237,953
Thurston	61,253	161	49,609	84	110,862	245	2,843	37	--	--	--	--	731	202	--	--	3,776	--	118,696
Wahkiakum	3,555	54	3,313	156	57,368	210	5,518	22	--	--	--	--	--	--	1,666	--	--	--	64,784
Whatcom	38,055	267	12,807	--	50,862	267	30,104	6	--	--	5,472	613	1,813	245	122	--	--	--	89,504
Total	3,004,843	18,703	688,354	11,757	3,693,197	30,460	469,127	12,287	--	--	699,807	53,691	141,782	9,187	18,411	330	38,587	392	5,172,158
Total live and dead	3,023,546		700,111		3,723,657		481,314		--		753,498		150,969		18,741		38,979		5,172,158
Eastern Washington:																			
Adams	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Asotin	942	--	8,056	--	8,998	--	2,378	--	--	-	7,306	87	--	--	--	--	--	--	18,769
Benton	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chelan	34,343	--	3,532	--	37,880	--	--	4	--	--	49,714	2,507	--	--	2,791	--	--	--	92,896
Columbia	1,082	--	2,141	--	3,223	--	--	--	--	--	8,042	97	--	--	193	--	--	--	11,555
Douglas	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ferry	10,331	--	2,802	--	13,133	--	--	90	--	--	32,973	1,955	67,215	44	96	--	--	--	115,506
Franklin	--	--	--	--	--	--	--	--	--	--	--	-	--	--	--	--	--	--	--
Garfield	276	--	1,979	--	2,255	--	--	--	--	--	7,972	96	--	--	--	--	--	--	10,323
Grant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Kittitas	45,403	119	8,048	36	53,451	155	11,060	47	--	--	52,653	1,508	--	--	1,311	--	--	--	120,185
Klickitat	41,711	--	5,313	--	47,024	--	11,455	1,302	--	--	291	14	10,722	676	--	--	--	--	71,484
Lincoln	--	--	445	--	445	--	--	4	--	--	--	--	--	--	--	--	--	--	449
Okanogan	7,837	--	16,194	--	24,031	--	16,924	33	--	--	60,478	1,182	24,960	1	115	--	--	--	127,724
Pend Oreille	20,194	100	17,466	8	37,660	108	1,819	2	30	--	16,773	6,915	172	--	40	--	--	--	63,519
Spokane	11,868	--	16,568	--	28,436	--	58	--	--	--	--	--	--	--	480	--	--	--	28,974
Stevens	29,965	--	36,247	--	66,212	--	7,782	356	579	--	14,556	2,146	19,783	--	60	--	2,106	--	113,580
Walla Walla	1,028	--	128	--	1,156	--	32	--	--	--	362	7	--	--	--	--	--	--	1,557
Whitman	28	--	3,085	--	3,113	--	--	--	--	--	--	--	--	--	--	--	--	--	3,113
Yakima	7,785	--	3,229	--	11,014	--	5,175	261	--	--	67,494	4,719	135,486	9,110	--	--	--	--	233,259
Total	212,798	219	125,233	44	338,031	263	56,683	2,099	609	--	318,614	21,233	258,333	9,831	5,036	--	2,106	--	1,012,893
Total live and dead	213,017		125,277		338,294		58,782		609		339,847		268,169		5,086		2,106		1,012,893
Total Washington	3,217,641	18,922	813,587	11,801	4,031,228	30,723	525,710	14,386	609	--	1,023,421	74,924	400,120	19,018	23,497	330	40,693	392	6,185,051
Total live and dead	3,236,563		825,388		4,061,951		540,096		609		1,098,345		419,138		23,827		41,085		6,185,051

[1] Includes volume in logs, poles, piling, shingles, bolts, etc.

[2] Compiled by Washington State Department of Natural Resources.

[3] Includes snags and down material existing prior to initial logging.

[4] Compiled by agencies, U.S. Bureau of Land Management, U.S. Forest Service, U.S. Bureau of Indian Affairs.

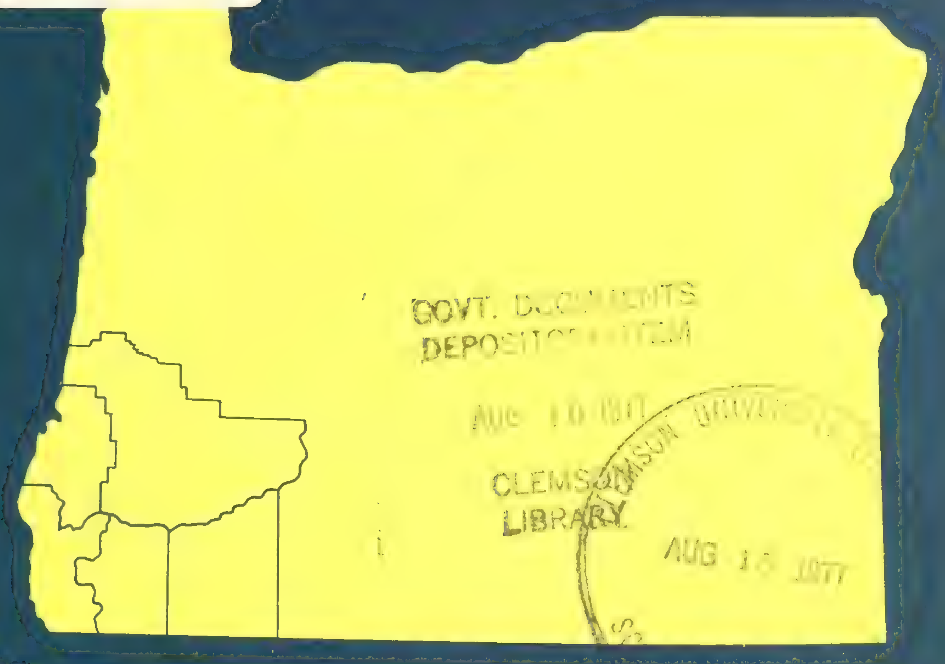
[5] Includes lands logged under jurisdiction of U.S. Department of Interior--Bonneville Power Administration, National Park Service, Bureau of Sport Fisheries and Wildlife, and Department of the Army.

Prepared by Forest Resources Evaluation Project, Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Portland, Oregon.

Keywords: Timber statistics, Washington.

13.80 : PNW-72

USDA Forest Service Resource Bulletin PNW-72
1977



GOVT. DOCUMENTS
DEPOSITORY ITEM
AUG 10 1977
CLEMSON
LIBRARY
AUG 18 1977

BER RESOURCES OF SOUTHWEST OREGON

PATRICIA M.
BASSETT

IC NORTHWEST
ST AND RANGE EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
PORTLAND, OREGON

RENEWABLE RESOURCES EVALUATION WORK UNIT

Charles Van Sickle, Project Leader
Donald R. Gedney, Principal Resource Analyst
John M. Berger, Compilation Supervisor
Dale R. Baer, Field Supervisor

ACKNOWLEDGMENTS

Cooperation and assistance of many public agencies and private timber companies are acknowledged.

The U.S. Forest Service supplied forest resource data for National Forests. The Bureau of Land Management, U.S. Department of the Interior, supplied resource data for Bureau of Land Management lands.

The county assessors and several private timber companies furnished ownership information. The southwest Oregon Forest Protective Associations, U.S. Department of Agriculture Forest Service, Bureau of Land Management, and several private timber companies provided maps and information on access to forest lands as well as general information related to forest management practices in southwest Oregon.

METRIC CONVERSIONS

1,000 acres = 404.69 hectares
1,000 cubic feet = 28.3 cubic meters
1 cubic foot per acre = 0.070 0 cubic meter per hectare
1 square-foot basal area per acre = 0.229 6 square meter per hectare
1 foot = 30.48 centimeters
1 inch = 2.54 centimeters
1 mile = 1 609.344 meters

TIMBER RESOURCES OF SOUTHWEST OREGON

REFERENCE ABSTRACT

Bassett, Patricia M.
1977. Timber resources of southwest Oregon. USDA For. Serv. Resour. Bull. PNW-72, 29 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report presents statistics from a 1973 inventory of timber resources of Douglas County and from a 1974 inventory of timber resources of Coos, Curry, Jackson, and Josephine Counties, Oregon. Tables presented are of forest area and of timber volume, growth, and mortality.

KEYWORDS: Forest surveys, statistics (forest), resources (timber), Oregon (southwest).

RESEARCH SUMMARY

Resource Bulletin PNW—72

1977

The southwest Oregon resource area of Coos, Curry, Douglas, Jackson, and Josephine Counties has a total land area of 8,147,000 acres, with 7,022,000 acres forested, and 6,129,000 acres in commercial forest land. The area has approximately 105 billion board feet of sawtimber (Scribner rule)--nearly 75 percent of it federally owned.

PREFACE

This report presents statistics from the latest inventory of the timber resources of five counties in southwest Oregon: Coos, Curry, Douglas, Jackson, and Josephine.

Field data for all lands except National Forests and lands administered by the Bureau of Land Management were collected by the Renewable Resources Evaluation Work Unit of the Pacific Northwest Forest and Range Experiment Station. Renewable Resources Evaluation (formerly Forest Survey) is a nationwide project of the Forest Service authorized by the McSweeney-McNary Forest Research Act of 1928 and amended by the Forest and Rangeland Renewable Resources Planning Act of 1974 (Public Law 93-378).

Renewable resources evaluations are conducted throughout the 50 States by the U.S. Forest Service Experiment Stations. The Pacific Northwest Forest and Range Experiment Station at Portland, Oregon, is responsible for resources evaluation in the States of Alaska, California, Hawaii, Oregon, and Washington.

The basic inventory data for lands administered by the Bureau of Land Management (BLM) were collected by that agency in 1966 for the Medford District and 1968-69 for other BLM lands. Current (1974) data were furnished by BLM for all field plots silviculturally treated or cutover since inventory, including the status of all plantations.

National Forest inventory data were collected by personnel of Region 6, Forest Service, at each National Forest. Dates of the basic inventories were: 1963 for the Siuslaw National Forest, 1966-67 for the Klamath National Forest, 1967 for the Rogue River and Siskiyou National Forests, 1967-68 for the Umpqua National Forest, and 1970-71 for the Willamette National Forest. All except the Willamette were updated to 1974 in the same manner as the BLM inventories. Field data for other ownerships were collected by Renewable Resources Evaluation personnel during the summers of 1973 for Douglas County and 1974 for Coos, Curry, Jackson, and Josephine Counties.

TABLE OF CONTENTS

Page

INTRODUCTION 1

HIGHLIGHTS 2

TABLES FOR SOUTHWEST OREGON, JANUARY 1, 1975 3-21

ACCURACY OF CURRENT INVENTORY DATA

Forest-land Area and Timber Volume 22

INVENTORY PROCEDURES 23
  National Forest and BLM 23
  Private and Other Public Lands 24

DEFINITION OF TERMS 25

PLANT SPECIES 28

LITERATURE CITED 29

TABLES

Page

1. Area by land class and county, southwest Oregon, January 1, 1975 3
2. Area of commercial forest land, by ownership class and county, southwest Oregon, January 1, 1975 3
3. Area of commercial forest land, by cubic-foot site and ownership classes, southwest Oregon, January 1, 1975 4
4. Area of commercial forest land, by stand-size and ownership classes, southwest Oregon, January 1, 1975 4
5. Area of commercial forest land, by forest type and ownership class, southwest Oregon, January 1, 1975 5
6. Area of noncommercial forest land, by ownership class, forest type, and land class, southwest Oregon, January 1, 1975 6-7
7. Volume of timber on commercial forest land, by class of timber and by softwoods and hardwoods, southwest Oregon, January 1, 1975 8
8. Volume of growing stock and sawtimber on commercial forest land, by ownership class and by softwoods and hardwoods, southwest Oregon, January 1, 1975 9
9. Volume of growing stock and sawtimber on commercial forest land, by county and ownership class, southwest Oregon, January 1, 1975 10
10. Volume of growing stock on commercial forest land, by species and ownership class, southwest Oregon, January 1, 1975 11
11. Volume of sawtimber on commercial forest land, by species and ownership class, southwest Oregon, January 1, 1975, International 1/4-inch rule 12
12. Volume of sawtimber on commercial forest land, by species and ownership class, southwest Oregon, January 1, 1975, Scribner rule 13
13. Volume of growing stock on commercial forest land, by species and diameter class, southwest Oregon, January 1, 1975 14
14. Volume of sawtimber on commercial forest land, by species and diameter class, southwest Oregon, January 1, 1975, International 1/4-inch rule 15
15. Volume of sawtimber on commercial forest land, by species and diameter class, southwest Oregon, January 1, 1975, Scribner rule 16
16. Net annual growth of growing stock on commercial forest land, by species and ownership class, southwest Oregon, January 1, 1975 17
17. Net annual growth of sawtimber on commercial forest land, by species and ownership class, southwest Oregon, January 1, 1975, International 1/4-inch rule 18
18. Average annual mortality of growing stock on commercial forest land, by species and ownership class, southwest Oregon, January 1, 1975 19
19. Average annual mortality of sawtimber on commercial forest land, by species and ownership class, southwest Oregon, January 1, 1975, International 1/4-inch rule 20

20. Timber harvest by ownership class, southwest Oregon, 1950-74 21

21. Sampling error of estimate of forest area and timber volume, other than National Forest and Bureau of Land Management ownerships, southwest Oregon, January 1, 1975 22

22. Approximate sampling error by size of area and volume, other than National Forest and Bureau of Land Management, southwest Oregon, January 1, 1975 23

23. Summary of inventories in southwest Oregon 24

INTRODUCTION

The southwest Oregon resource area, comprised of Coos, Curry, Douglas, Jackson, and Josephine Counties, has a total land area of 8,147,000 acres. Forest land covers approximately 7,022,000 acres, of which 87 percent (6,129,000 acres) is classified as commercial forest land. The area can be divided into five distinct geographic regions--the Cascade Range, the Coast Ranges, the Klamath Mountains, the dry interior valley of Douglas County, and the Rogue River Valley. Precipitation ranges from less than 18 inches in the "Agate Desert" north of Medford to 80 inches near Coos Bay. The hot summers of the interior contrast sharply with the cool summers along the coast.

Natural vegetation varies from near-rain forest along the coast to arid grassland in the interior valleys. Over 30 species of trees grow in the area, although by far the most abundant is Douglas-fir, ranging from the wet coastal forests to the dry interior grasslands. The coastal forests also include stands of western hemlock and Sitka spruce. Redwoods in the northern portion of their range are found in the southwestern part of the area; a mixture of Douglas-fir and the unique Port-Orford-cedar is also found. Extensive hardwood stands are scattered throughout the area on burned or cutover sites formerly stocked with conifers. Natural undisturbed stands of hardwoods form a major component in the western Klamath Mountains and southern Coast Ranges and in lower elevations of the interior.

Red alder is the major hardwood in coastal Coos County; tanoak predominates in the southern coastal and Klamath Mountains; and Oregon white oak, California black oak, and madrone are the most common hardwoods in the interior. Canyon live oak occurs on some of the harsher sites.

Interior stands often consist of white and grand firs, incense-cedar, and sugar and ponderosa pines, although Douglas-fir usually predominates. Stands of noble and Shasta red firs, mountain hemlock, and western white and lodgepole pines are found at higher elevations.

Cutting patterns have affected the natural composition of the forest. In the past, partial cutting predominated in Jackson and Josephine Counties but clearcutting occurred in most of Douglas, Coos, and coastal Curry County. In the northern coastal areas, regeneration is favored by moist conditions and is usually hampered only by brush competition. Farther south along the coast, regeneration is more difficult because of harsher sites and tanoak competition. Inland, regeneration hazards increase as sites become drier and harsher with the severest conditions for regeneration occurring in the valley margins.

This five county area has a population of about 270,000 people, comprising 13 percent of the State's total population. Major cities include Coos Bay, a seaport for forest products shipping; Roseburg, the "timber capital" of the Nation; Grants Pass, the Rogue River tourist center; Medford, near Crater Lake, an important industrial and service center for the Rogue River Valley; and the college town of Ashland whose Shakespearean festival is a major attraction each summer.

Important industries in southwest Oregon are mining, ranching, farming, tourism, and timber. Communities in the area rely heavily on the timber industry for employment. The industry provides jobs for approximately 21,000 people; two-thirds of these jobs are associated with the sawmill and veneer and plywood industries.

The southwest Oregon area plays a major role in the local, regional, and national timber supply situation. In the 5 years from 1970 to 1974, the forests in these five counties produced nearly one-third of the State's timber harvest. Approximately 5 percent of the Nation's lumber and one-fifth of its veneer and plywood are produced in the area.

The forest statistics in this report will be of special interest to planners and policymakers involved with such problems as increased timber demands, regeneration, and timber harvesting, as well as to resource users and others interested in the current and future status of the timber of this area.

HIGHLIGHTS

COMMERCIAL FOREST LAND

- Covers 6,129,000 acres, 87 percent of the forest land, and 75 percent of the total land area;
- Has sawtimber stands on 65 percent of its area; and
- Is composed of 55-percent Douglas-fir type, 19-percent other softwood types, and 22-percent hardwood types; 4-percent is nonstocked.

GROWING STOCK VOLUME

- Totals 23,251 million cubic feet;
- Is comprised of 91-percent softwoods, 9-percent hardwoods;
- Is over 92-percent sawtimber-size trees.

SAWTIMBER VOLUME

- Totals 104,995 million board feet, Scribner rule (130,200 million board feet, International 1/4-inch rule);
- Is 71-percent Douglas-fir species;
- Contains only 5-percent hardwoods;
- Is 79 percent in trees over 21 inches in d.b.h.

OWNERSHIP DISTRIBUTION

Ownership	Percent of commercial forest land area	Percent of cubic-foot growing stock volume	Percent of sawtimber volu
National Forest	33	45	47
Bureau of Land Management	22	26	26
Other public	3	3	3
Forest industry	27	19	19
Other private	15	7	5

NET ANNUAL GROWTH

- Totals 271,932,000 cubic feet (1,341,854,000 board feet, International 1/4-inch rule);
- Totals 81 percent in softwoods.

NET ANNUAL MORTALITY

- Totals 135,985,000 cubic feet (671,745,000 board feet, International 1/4-inch rule);
- Contains 87-percent softwoods.

TABLES FOR SOUTHWEST OREGON, JANUARY 1, 1975

Table 1--*Area by land class and county, southwest Oregon, January 1, 1975*

(In thousand acres)

Land class	All counties	Coos	Curry	Douglas	Jackson	Josephine
Forest land:						
Commercial	6,129	847	753	2,641	1,157	731
Deferred	19	--	9	--	10	--
Productive reserved	79	8	47	7	5	12
Unproductive	795	13	140	150	310	182
Total	7,022	868	949	2,798	1,482	925
Nonforest land[1]	1,125	159	92	442	318	114
Total area[2]	8,147	1,027	1,041	3,240	1,800	1,039

[1] Includes cropland, pasture and range, swampland, industrial and urban areas, powerline clearings, railroads, and all improved roads and highways, and water as classified by Forest Survey standards but defined by the Bureau of Census as land.

[2] Source: United States Bureau of the Census, Land and Water Area of the United States, 1970.

Table 2--*Area of commercial forest land, by ownership class and county, southwest Oregon, January 1, 1975*

(In thousand acres)

Ownership class	All counties[1]	Coos	Curry	Douglas	Jackson	Josephine
National Forest	2,019	64	412	897	388	258
Bureau of Land Management	1,329	156	57	609	277	230
Other public	178	78	2	56	6	36
Total public[1]	3,526	298	471	1,562	671	524
Private:						
Forest industry	1,657	343	165	773	331	45
Other private:						
Farmer-owned	522	109	60	235	73	45
Miscellaneous	424	97	58	71	82	116
Total private[1]	2,604	549	283	1,079	487	206
All ownerships[1]	6,129	847	753	2,641	1,157	731

[1] Totals may be off because of rounding.

Table 3--*Area of commercial forest land, by cubic-foot site and ownership classes, southwest Oregon, January 1, 1975*

(In thousand acres)

Site class[1] (cubic feet)	All ownerships[2]	National Forest	Bureau of Land Manage.	Other public	Forest industry	Other private
225 or more	59	11	3	--	24	21
165 to 224	605	107	141	38	222	97
120 to 164	1966	494	496	67	694	215
85 to 119	1516	570	340	16	423	167
50 to 84	1496	749	335	25	173	213
20 to 49	487	87	14	30	121	233
All classes[2]	6,129	2,019	1,329	178	1,657	946

[1] A classification in terms of capacity for cubic-foot annual growth per acre at culmination of mean annual growth in fully stocked stands.

[2] Totals may be off because of rounding.

Table 4--*Area of commercial forest land, by stand-size and ownership classes, southwest Oregon, January 1, 1975*

(In thousand acres)

Stand-size class	All ownerships[1]	National Forest	Bureau of Land Manage.	Other public	Forest industry	Other private
Sawtimber stands:						
Large sawtimber[2]	2,582	1,220	732	55	443	132
Small sawtimber[3]	1,461	351	211	84	426	389
Total[1]	4,044	1,572	943	139	869	521
Poletimber stands	596	111	40	16	215	214
Sapling and seedling stands	1,261	291	293	23	475	179
Nonstocked areas	232	46	54	--	99	33
All classes[1]	6,129	2,019	1,329	178	1,657	946

[1] Totals may be off because of rounding.

[2] Large sawtimber includes stands with the majority of the sawtimber stocking in trees 21.0-inch d.b.h. and larger.

[3] Small sawtimber includes stands with the majority of the sawtimber stocking in conifer trees 9.0 to 20.9-inches d.b.h. and hardwood trees 11.0 to 20.9-inch d.b.h.

Table 5--*Area of commercial forest land, by forest type and ownership class, southwest Oregon, January 1, 1975*

(In thousand acres)

Forest type	All ownerships[1/]	National Forest	Bureau of Land Manage.	Other public	Forest industry	Other private
Douglas-fir	3,392	1,164	1,003	85	879	261
White fir	236	133	54	--	37	12
Grand fir	106	20	10	2	36	38
Shasta red fir	70	70	--	--	--	--
Subalpine fir	5	5	--	--	--	--
Pacific silver fir	14	14	--	--	--	--
Noble fir	20	18	2	--	--	--
Ponderosa pine	90	33	27	--	9	21
Jeffrey pine	25	2	--	--	23	--
Sugar pine	25	9	16	--	--	--
Western white pine	17	17	--	--	--	--
Lodgepole pine	82	68	--	--	--	14
Knobcone pine	14	14	[2/]	--	--	--
Engelmann spruce	1	1	--	--	--	--
Sitka spruce	29	4	--	--	12	13
Redwood	11	5	--	--	6	--
Mountain hemlock	85	60	25	--	--	--
Western hemlock	85	36	--	--	41	8
Incense-cedar	111	11	22	2	39	37
Port-Orford-cedar	76	19	4	9	29	15
Western redcedar	51	7	7	--	31	6
Red alder	350	16	15	44	170	105
Maple	37	--	8	--	21	8
Black oak	104	6	15	--	32	51
Oregon white oak	78	--	1	9	6	62
Canyon live oak	22	22	--	--	--	--
Tanoak	162	162	--	--	--	--
California laurel	2	2	--	--	--	--
Chinkapin	30	29	1	--	--	--
Madrone	316	28	38	13	67	170
Other hardwoods	215	1	25	12	109	68
Noncommercial hardwoods	34	--	2	--	10	22
Nonstocked	232	46	54	--	99	33
All types[1/]	6,129	2,019	1,329	178	1,657	946

[1/] Totals may be off because of rounding.

[2/] Less than 500 acres.

Table 6--*Area of noncommercial forest land, by ownership class, forest type, and land class, southwest Oregon, January 1, 1975*

(In thousand acres)

Forest type and land class	All ownerships[1]	National Forest	Bureau of Land Manage.	Other public	Forest industry	Other private
RESERVED						
Productive:[2]						
Douglas-fir	45	27	14	4	--	--
True firs	[3]	[3]	--	--	--	--
Fir-hemlock	[3]	[3]	--	--	--	--
Ponderosa pine	3	1	[3]	2	--	--
Jeffrey pine	[3]	[3]	--	--	--	--
Sugar pine	12	12	[3]	[3]	--	--
Western white pine	1	1	--	--	--	--
Lodgepole pine	3	1	--	2	--	--
Sitka spruce	5	1	--	4	--	--
Port-Orford-cedar	[3]	--	--	[3]	--	--
Alder	[3]	--	--	[3]	--	--
Cottonwood	[3]	--	[3]	--	--	--
Hardwood	6	6	--	[3]	--	--
Unclassified	2	2	--	--	--	--
Total[1]	79	52	15	12	--	--
Unproductive:[4]						
Rocky[5]	21	21	--	--	--	--
Low site[6]	4	3	1	--	--	--
Oak-madrone	1	--	[3]	1	--	--
Chaparral	2	--	[3]	2	--	--
Cottonwood	[3]	--	--	[3]	--	--
Unclassified	[3]	--	--	[3]	--	--
Total[1]	28	24	1	3	--	--
Total reserved[1]	107	76	16	15	--	--
UNRESERVED						
Unproductive:						
Rocky[5]						
Douglas-fir	65	19	46	--	--	--
White fir	3	--	3	--	--	--
Grand fir	1	--	1	--	--	--
Shasta red fir	2	2	--	--	--	--
Ponderosa pine	10	--	10	--	--	--
Jeffrey pine	8	--	8	--	--	--
Lodgepole pine	3	3	--	--	--	--
Mountain hemlock	3	3	--	--	--	--
Western hemlock	9	2	--	--	--	7
Incense-cedar	1	--	1	--	--	--
Black oak	3	--	3	--	--	--
Oregon white oak	1	[3]	1	--	--	--
Madrone	1	--	1	--	--	--
Other hardwoods	1	--	1	--	--	--
Nonstocked	9	--	9	--	--	--
Unclassified	101	101	--	--	--	--
Total rocky[1]	222	130	85	--	--	7

See footnotes at end of table.

Table 6--*Area of noncommercial forest land, by ownership class, forest type, and land class, southwest Oregon, January 1, 1975*--Continued

(In thousand acres)

Forest type and land class	All ownerships[1]	National Forest	Bureau of Land Manage.	Other public	Forest industry	Other private
Low site[6]						
Douglas-fir	26	--	9	--	--	17
White fir	[3]	[3]	--	--	--	--
Ponderosa pine	12	--	4	--	--	8
Jeffrey pine	5	--	4	1	--	--
Lodgepole pine	1	--	1	--	--	--
Oregon white oak	6	--	1	3	2	--
Noncommercial hardwoods	3	1	2	--	--	--
Nonstocked	11	--	--	3	--	8
Unclassified	83	83	--	--	--	--
Total low site[1]	146	84	20	6	2	34
Critical watershed[7]						
Douglas-fir	6	4	2	--	--	--
Ponderosa pine	4	--	4	--	--	--
Madrone	1	--	1	--	--	--
Nonstocked	2	--	2	--	--	--
Total critical watershed[1]	14	4	10	--	--	--
Adverse location[7]						
Douglas-fir	17	2	15	--	--	--
Lodgepole pine	2	2	--	--	--	--
Black oak	3	--	3	--	--	--
Oregon white oak	2	--	2	--	--	--
Madrone	3	--	3	--	--	--
Nonstocked	1	--	1	--	--	--
Total adverse location[1]	29	4	25	--	--	--
Junipers	8	--	1	--	7	--
Oak-madrone	224	--	43	4	16	161
Chaparral	112	74	35	2	1	--
Willow	10	--	--	--	2	8
Total unreserved[1]	767	296	220	13	29	211
Total noncommercial forest[1]	874	372	236	28	29	211

[1] Totals may be off because of rounding.

[2] Includes forest land estimated to be capable of growing 20 cubic feet or more per acre primarily in the Rogue River Wild River Area, Kalmiopsis Wilderness Area, and various State and county parks.

[3] Less than 500 acres.

[4] Forest types not determined.

[5] Includes areas capable of growing merchantable trees but too steep or rocky for timber management.

[6] Areas stocked with commercial tree species but incapable of growing 20 cubic feet per acre because of soil and climatic factors; forest types not determined.

[7] Includes unstable areas that cannot be logged without seriously affecting the watershed and small isolated patches of commercial forest land on steep mountainsides; forest types not determined.

Table 7--*Volume of timber on commercial forest land, by class of timber and by softwoods and hardwoods, southwest Oregon, January 1, 1975*

(In million cubic feet)

Class of timber	All species[1]	Softwoods	Hardwoods
Sawtimber trees:			
Saw-log portion	19,921	18,821	1,100
Upper-stem portion	1,404	1,276	128
Total[1]	21,325	20,097	1,228
Poletimber trees	1,924	1,164	760
All growing stock trees[1]	23,251	21,263	1,988
Sound cull trees	496	105	391
Rotten cull trees	1,018	815	204
Salvable dead trees	489	485	4
All timber[1]	25,254	22,668	2,587

[1] Totals may be off because of rounding.

Table 8--*Volume of growing stock and sawtimber on commercial forest land, by ownership class and by softwoods and hardwoods, southwest Oregon, January 1, 1975*

Ownership class	Average volume per acre	Total volume		
		All species[1]	Softwoods	Hardwoods
	Cubic feet	Million cubic feet		
Growing stock:[2]				
National Forest	5,241	10,581	10,156	425
Bureau of Land Management	4,473	5,945	5,535	410
Other public	3,921	698	514	185
Forest industry	2,678	4,438	3,897	540
Other private	1,680	1,589	1,161	428
All ownerships[1]	3,794	23,251	21,263	1,988
	Board feet	Million board feet		
Sawtimber (International 1/4-inch rule):[3]				
National Forest	30,211	60,995	59,410	1,585
Bureau of Land Management	25,059	33,303	32,018	1,284
Other public	22,646	4,031	3,119	912
Forest industry	15,147	25,098	23,493	1,605
Other private	7,163	6,776	5,756	1,021
All ownerships[1]	21,243	130,200	123,795	6,405
Sawtimber (Scribner rule):[4]				
National Forest	23,728	47,906	46,641	1,265
Bureau of Land Management	23,035	30,613	29,353	1,260
Other public	16,933	3,014	2,286	728
Forest industry	11,398	18,887	17,571	1,316
Other private	4,839	4,578	3,745	833
All ownerships[1]	17,131	104,995	99,594	5,401

[1] Totals may be off because of rounding.

[2] Includes trees 5.0-inch d.b.h. and larger.

[3] Includes softwood trees 9.0-inch d.b.h. and larger and hardwood trees 11.0-inch d.b.h. and larger.

[4] Includes trees 11.0-inch d.b.h. and larger.

Table 9--*Volume of growing stock and sawtimber on commercial forest land, by county and ownership class, southwest Oregon, January 1, 1975*

County	Total[1]	National Forest	Bureau of Land Manage.	Other public	Forest industry	Other private
			Million cubic feet			
Growing stock[2]						
Coos	3,268	327	1,012	441	998	490
Curry	2,521	1,782	252	11	213	261
Douglas	11,291	5,537	2,859	189	2,290	416
Jackson	3,896	1,833	988	13	855	207
Josephine	2,275	1,102	833	44	81	215
Total[1]	23,251	10,581	5,945	698	4,438	1,589
			Million board feet			
Sawtimber (International 1/4-inch rule):[3]						
Coos	21,645	5,139	6,215	2,592	5,285	2,414
Curry	13,885	10,511	1,309	75	875	1,115
Douglas	65,875	32,689	16,514	1,099	13,977	1,596
Jackson	20,156	9,622	4,925	66	4,586	956
Josephine	8,643	3,034	4,340	199	375	695
Total[1]	130,200	60,995	33,303	4,031	25,098	6,776
			Million board feet			
Sawtimber (Scribner rule):[4]						
Coos	17,346	3,880	5,767	1,931	4,019	1,749
Curry	11,057	8,303	1,220	63	649	822
Douglas	53,442	25,488	15,306	843	10,772	1,033
Jackson	15,651	7,442	4,405	45	3,208	551
Josephine	7,502	2,793	3,916	131	240	423
Total[1]	104,995	47,906	30,613	3,014	18,887	4,578

[1] Totals may be off because of rounding.

[2] Includes trees 5.0-inch d.b.h. and larger.

[3] Includes softwood trees 9.0-inch d.b.h. and larger and hardwood trees 11.0-inch d.b.h. and larger.

[4] Includes trees 11.0-inch d.b.h. and larger.

Table 10--*Volume of growing stock on commercial forest land, by species and ownership class, southwest Oregon, January 1, 1975*

(In million cubic feet)

Species	All ownerships1/	National Forest	Bureau of Land Manage.	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	15,067	6,632	4,375	439	2,891	730
Shasta red fir	248	247	--	--	--	1
True firs	1,784	1,212	253	4	254	61
Ponderosa and Jeffrey pines	560	187	185	6	124	58
Sugar pine	616	389	155	--	65	7
Western white pine	168	165	3	--	--	--
Lodgepole pine	122	111	--	--	--	11
Spruces	102	7	--	24	13	58
Hemlocks	1,436	763	315	16	279	63
Redwood	53	37	--	—	16	--
Incense-cedar	452	155	112	8	80	97
Western redcedar	366	74	110	—	144	38
Other softwoods2/	286	177	26	17	31	35
Total1/	21,263	10,156	5,535	514	3,897	1,161
Hardwoods:						
Red alder	680	54	63	160	247	156
Tanoak	358	219	50	--	43	46
Other hardwoods3/	949	152	297	25	250	225
Total1/	1,988	425	410	185	540	428
All species1/	23,251	10,581	5,945	698	4,438	1,589

1/Totals may be off because of rounding.

2/Includes knobcone pine, Port-Orford-cedar, and Alaska cedar.

3/Includes bigleaf maple, madrone, golden chinkapin, Oregon ash, cottonwood, oaks, and California laurel (Oregon myrtle).

Table 11--*Volume of sawtimber on commercial forest land, by species and ownership class, southwest Oregon, January 1, 1975, International 1/4-inch rule*

(In million board feet)

Species	All ownerships[1]	National Forest	Bureau of Land Manage.	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	91,316	41,082	25,907	2,783	17,920	3,624
Shasta red fir	1,464	1,457	--	--	--	7
True firs	9,185	6,324	1,259	20	1,323	259
Ponderosa and Jeffrey pines	3,224	1,112	1,031	37	735	309
Sugar pine	3,845	2,500	891	--	415	39
Western white pine	890	874	16	--	--	--
Lodgepole pine	266	221	--	--	--	45
Spruces	591	40	--	111	78	362
Hemlocks	6,931	3,404	1,722	59	1,456	290
Redwood	340	253	--	--	87	--
Incense-cedar	2,306	831	509	44	416	506
Western redcedar	2,043	342	553	--	930	218
Other softwoods[2]	1,392	969	129	65	133	97
Total[1]	123,795	59,410	32,018	3,119	23,493	5,756
Hardwoods:						
Red alder	2,530	358	259	838	710	366
Tanoak	1,256	898	130	--	84	144
Other hardwoods[3]	2,619	329	895	74	811	509
Total[1]	6,405	1,585	1,284	912	1,605	1,021
All species[1]	130,200	60,995	33,303	4,031	25,098	6,776

[1] Totals may be off because of rounding.

[2] Includes knobcone pine, Port-Orford-cedar, and Alaska cedar.

[3] Includes bigleaf maple, madrone, golden chinkapin, Oregon ash, cottonwood, oaks, and California laurel (Oregon myrtle).

Table 12--*Volume of sawtimber on commercial forest land, by species and ownership class, southwest Oregon, January 1, 1975, Scribner rule*

(In million board feet)

Species	All ownerships[1]	National Forest	Bureau of Land Manage.	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	74,776	32,673	23,860	2,113	13,740	2,391
Shasta red fir	1,126	1,124	--	--	--	2
True firs	6,999	4,894	1,124	8	825	148
Ponderosa and Jeffrey pines	2,542	883	938	20	510	191
Sugar pine	3,143	1,970	833	--	313	27
Western white pine	681	667	14	--	--	--
Lodgepole pine	190	164	--	--	--	26
Spruces	382	28	--	42	51	261
Hemlocks	5,247	2,581	1,492	37	966	171
Redwood	276	203	--	--	73	--
Incense-cedar	1,677	560	463	29	297	329
Western redcedar	1,631	263	500	--	721	147
Other softwoods[2]	924	632	129	37	74	52
Total[1]	99,594	46,641	29,353	2,286	17,571	3,745
Hardwoods:						
Red alder	2,024	234	257	667	575	291
Tanoak	955	635	129	--	70	121
Other hardwoods[3]	2,421	396	874	61	670	420
Total[1]	5,401	1,265	1,260	728	1,316	833
All species[1]	104,995	47,906	30,613	3,014	18,887	4,578

[1] Totals may be off because of rounding.

[2] Includes knobcone pine, Port-Orford-cedar, and Alaska cedar.

[3] Includes bigleaf maple, madrone, golden chinkapin, Oregon ash, cottonwood, oaks, and California laurel (Oregon myrtle).

Table 13--*Volume of growing stock on commercial forest land, by species and diameter class, southwest Oregon, January 1, 1975*

(Million cubic feet)

Species	Diameter class (inches at breast height)										
	All classes[1]	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger
Softwoods:												
Douglas-fir	15,067	285	378	412	498	520	533	603	605	2,548	3,267	5,418
Shasta red fir	248	5	7	9	13	14	14	14	17	61	50	46
True firs	1,784	56	81	99	111	131	133	120	135	414	264	239
Ponderosa and Jeffrey pines	560	7	13	18	23	23	43	32	35	117	119	128
Sugar pine	616	8	4	8	12	15	13	13	25	94	164	263
Western white pine	168	5	6	8	6	10	7	13	11	56	22	24
Lodgepole pine	122	17	23	24	26	14	9	5	3	2	--	--
Spruces	102	2	2	12	8	5	7	11	3	29	22	1
Hemlocks	1,436	73	97	98	127	111	130	114	108	324	146	111
Redwood	53	--	--	1	--	2	2	2	3	6	15	24
Incense-cedar	452	10	12	12	14	23	19	32	21	91	108	108
Western redcedar	366	4	12	13	15	12	12	18	15	59	78	125
Other softwoods[2]	286	22	21	15	18	17	13	21	9	49	40	62
Total[1]	21,263	496	657	729	869	899	932	995	989	3,852	4,296	6,549
Hardwoods:												
Red alder	680	65	70	87	78	88	87	77	57	64	5	--
Tanoak	358	62	56	46	36	35	25	20	16	40	21	1
Other hardwoods[3]	949	120	148	124	130	93	67	63	54	99	36	12
Total[1]	1,988	247	274	257	244	216	179	161	128	203	61	14
All species[1]	23,251	743	931	986	1,113	1,115	1,111	1,156	1,117	4,055	4,357	6,563

[1] Totals may be off because of rounding.

[2] Includes knobcone pine, Port-Orford-cedar, and Alaska cedar.

[3] Includes bigleaf maple, madrone, golden chinkapin, Oregon ash, cottonwood, oaks, and California laurel (Oregon myrtle).

Table 14--*Volume of sawtimber on commercial forest land, by species and diameter class, southwest Oregon, January 1, 1975, International 1/4-inch rule*

(In million board feet)

Species	Diameter class (inches at breast height)									
	All classes[1/]	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger
Softwoods:										
Douglas-fir	91,316	1,902	2,466	2,787	3,044	3,568	3,654	16,006	21,131	36,760
Shasta red fir	1,464	34	55	68	78	81	97	392	334	324
True firs	9,185	323	506	637	709	651	727	2,443	1,682	1,507
Ponderosa and Jeffrey pines	3,224	63	94	116	245	174	203	725	752	853
Sugar pine	3,845	42	51	75	62	70	134	578	1,070	1,765
Western white pine	890	31	24	50	39	63	68	328	138	149
Lodgepole pine	266	21	98	56	39	25	17	10	--	--
Spruces	591	51	42	33	41	63	23	185	149	5
Hemlocks	6,931	333	626	569	699	629	610	1,896	903	664
Redwood	340	2	--	8	9	7	17	37	96	163
Incense-cedar	2,306	39	50	99	82	155	100	499	627	652
Western redcedar	2,043	50	64	56	61	95	80	351	471	818
Other softwoods[2/]	1,392	64	72	87	60	102	51	291	246	421
Total[1/]	123,795	2,955	4,146	4,642	5,169	5,683	5,781	23,740	27,598	44,082
Hardwoods:										
Red alder	2,530	--	353	457	492	457	343	407	22	--
Tanoak	1,256	--	203	198	157	131	117	280	163	7
Other hardwoods[3/]	2,619	--	474	391	295	313	288	547	234	78
Total[1/]	6,405	--	1,030	1,046	944	901	748	1,234	420	85
All species[1/]	130,200	2,955	5,176	5,688	6,113	6,584	6,529	24,974	28,018	44,167

[1/] Totals may be off because of rounding.

[2/] Includes knobcone pine, Port-Orford-cedar, and Alaska cedar.

[3/] Includes bigleaf maple, madrone, golden chinkapin, Oregon ash, cottonwood, oaks, and California laurel (Oregon myrtle).

Table 15--*Volume of sawtimber on commercial forest land, by species and diameter class, southwest Oregon, January 1, 1975, Scribner rule*

(In million board feet)

Species	Diameter class (inches at breast height)								
	All classes[1]	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger
Softwoods:									
Douglas-fir	74,776	1,537	1,906	2,190	2,657	2,828	13,085	18,056	32,520
Shasta red fir	1,126	35	44	52	56	70	305	280	284
True firs	6,999	320	420	480	469	545	1,980	1,446	1,339
Ponderosa and Jeffrey pines	2,542	51	75	160	127	152	589	648	739
Sugar pine	3,143	36	50	46	51	101	460	881	1,519
Western white pine	681	18	33	26	47	49	262	116	129
Lodgepole pine	190	72	42	30	18	12	7	4	5
Spruces	382	23	20	25	41	16	135	116	4
Hemlocks	5,247	403	399	500	475	480	1,569	812	609
Redwood	276	--	6	6	6	15	28	79	138
Incense-cedar	1,677	27	53	51	95	70	363	496	522
Western redcedar	1,631	41	37	42	66	62	295	392	694
Other softwoods[2]	924	31	50	37	67	32	205	176	325
Total[1]	99,594	2,594	3,135	3,645	4,175	4,431	19,283	23,502	38,826
Hardwoods:									
Red alder	2,024	267	350	389	371	283	342	20	--
Tanoak	955	140	144	116	100	73	232	143	7
Other hardwoods[3]	2,421	412	349	270	287	257	531	247	71
Total[1]	5,401	819	843	775	758	613	1,104	410	78
All species[1]	104,995	3,413	3,979	4,420	4,933	5,044	20,387	23,912	38,904

[1] Totals may be off because of rounding.

[2] Includes knobcone pine, Port-Orford-cedar, and Alaska cedar.

[3] Includes bigleaf maple, madrone, golden chinkapin, Oregon ash, cottonwood, oaks, and California laurel (Oregon myrtle).

Table 16--*Net annual growth of growing stock on commercial forest land, by species and ownership class, southwest Oregon, January 1, 1975*

(In million cubic feet)

Species	All ownerships[1]	National Forest	Bureau of Land Manage.	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	138.1	38.5	27.7	8.4	38.6	24.9
Shasta red fir	[2]-1.7	[2]-1.8	--	--	--	.1
True firs	32.5	16.5	3.8	.3	8.8	3.1
Ponderosa and Jeffrey pines	5.8	1.8	1.5	[2]-.1	1.3	1.3
Sugar pine	2.3	1.6	.2	[2]-.2	.5	.2
Western white pine	.8	.8	[3]	--	--	--
Lodgepole pine	1.5	1.1	--	--	--	.4
Spruces	3.4	[3]	--	.8	.3	2.3
Hemlocks	24.6	8.7	2.3	1.1	8.4	4.1
Redwood	.3	.3	--	--	--	—
Incense-cedar	4.1	1.3	.7	[3]	.6	1.5
Western redcedar	4.2	1.2	1.0	--	.9	1.1
Other softwoods[4]	4.8	.3	.6	.5	1.6	1.8
Total[1]	220.7	70.3	37.8	10.8	61.0	40.8
Hardwoods:						
Red alder	22.8	.4	.7	[3]	13.3	8.4
Tanoak	2.1	--	1.6	--	[2]-.2	.7
Other hardwoods[5]	26.4	6.4	9.1	.2	3.5	7.1
Total[1]	51.3	6.8	11.5	.3	16.5	16.2
All species[1]	272.0	77.1	49.3	11.1	77.5	57.0

---

[1] Totals may be off because of rounding.

[2] Negative net annual growth is the result of net annual mortality exceeding gross annual growth.

[3] Less than 0.05 million cubic feet.

[4] Includes knobcone pine, Port-Orford-cedar, and Alaska cedar.

[5] Includes bigleaf maple, madrone, golden chinkapin, Oregon ash, cottonwood, oaks, and California laurel (Oregon myrtle).

Table 17--*Net annual growth of sawtimber on commercial forest land, by species and ownership class, southwest Oregon, January 1, 1975, International 1/4-inch rule*

(In million board feet)

Species	All ownerships[1]	National Forest	Bureau of Land Manage.	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	721.1	217.7	135.8	43.8	199.6	124.3
Shasta red fir	[2]-12.6	[2]-13.4	--	--	--	.8
True firs	182.1	92.3	18.7	1.2	56.3	13.7
Ponderosa and Jeffrey pines	35.7	10.2	6.3	.3	9.0	10.0
Sugar pine	13.6	8.7	2.1	[2]-1.3	3.2	.9
Western white pine	[2]-4.0	[2]-4.2	.2	--	--	--
Lodgepole pine	5.3	4.8	--	--	--	.5
Spruces	28.3	.3	--	7.6	3.4	17.0
Hemlocks	118.7	33.1	12.2	3.8	52.3	17.3
Redwood	5.6	1.9	--	--	3.7	--
Incense-cedar	18.9	4.8	2.3	.2	3.3	8.2
Western redcedar	25.9	4.6	4.8	--	8.7	7.8
Other softwoods[3]	24.8	8.0	2.2	2.8	7.1	4.7
Total[1]	1,163.3	368.8	184.5	58.4	346.5	205.1
Hardwoods:						
Red alder	67.2	4.0	6.4	6.2	36.5	14.1
Tanoak	9.3	--	5.0	--	1.0	3.3
Other hardwoods[4]	102.0	25.0	30.8	1.5	29.0	15.8
Total[1]	178.6	29.0	42.2	7.6	66.5	33.2
All species[1]	1,341.9	397.8	226.8	66.0	413.1	238.2

[1] Totals may be off because of rounding.

[2] Negative net annual growth is the result of net annual mortality exceeding gross annual growth.

[3] Includes knobcone pine, Port-Orford-cedar, and Alaska cedar.

[4] Includes bigleaf maple, madrone, golden chinkapin, Oregon ash, cottonwood, oaks, and California laurel (Oregon myrtle).

Table 18--*Average annual mortality of growing stock on commercial forest land, by species and ownership class, southwest Oregon, January 1, 1975*

(In million cubic feet)

Species	All ownerships[1]	National Forest	Bureau of Land Manage.	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	80.4	26.9	32.8	0.9	16.1	3.8
Shasta red fir	1.6	1.6	--	--	--	--
True firs	11.5	5.8	2.8	--	2.6	.4
Ponderosa and Jeffrey pines	4.7	1.7	1.4	.2	1.0	.5
Sugar pine	5.3	2.9	1.7	.2	.5	--
Western white pine	2.3	2.2	.1	--	--	--
Lodgepole pine	1.2	1.1	--	--	--	.2
Spruces	.9	[2]	--	.2	.5	.2
Hemlocks	6.4	2.9	1.5	.3	1.4	.2
Redwood	.1	.1	--	--	--	--
Incense-cedar	1.4	.2	.7	.1	.3	.1
Western redcedar	1.3	[1]	.3	--	.9	--
Other softwoods[3]	1.1	.5	--	.2	--	.4
Total[1]	118.3	45.9	41.3	2.0	23.2	5.9
Hardwoods:						
Red alder	7.2	.6	.6	2.6	1.8	1.6
Tanoak	2.4	--	.1	--	1.8	.5
Other hardwoods[4]	8.1	.6	1.5	.4	3.2	2.4
Total[1]	17.7	1.2	2.2	3.0	6.8	4.6
All species[1]	136.0	47.1	43.4	5.0	30.0	10.4

---

[1] Totals may be off because of rounding.

[2] Less than 0.05 million cubic feet.

[3] Includes knobcone pine, Port-Orford-cedar, and Alaska cedar.

[4] Includes bigleaf maple, madrone, golden chinkapin, Oregon ash, cottonwood, oaks, and California laurel (Oregon myrtle).

Table 19--*Average annual mortality of sawtimber on commercial forest land, by species and ownership class, southwest Oregon, January 1, 1975, International 1/4-inch rule*

(In million board feet)

Species	All ownerships[1]	National Forest	Bureau of Land Manage.	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	458.7	167.7	183.4	5.7	91.2	10.8
Shasta red fir	10.4	10.4	--	--	--	--
True firs	58.1	31.1	14.6	--	11.0	1.4
Ponderosa and Jeffrey pines	16.8	4.0	6.8	1.0	4.3	.7
Sugar pine	32.5	19.3	8.7	1.4	3.1	--
Western white pine	13.0	12.2	.8	--	--	--
Lodgepole pine	3.1	2.0	--	--	--	1.1
Spruces	1.6	.2	--	--	1.4	--
Hemlocks	26.1	11.7	8.1	--	5.2	1.1
Redwood	.7	.7	--	--	--	--
Incense-cedar	5.2	1.0	2.6	.4	.9	.4
Western redcedar	4.1	.1	1.5	--	2.5	--
Other softwoods[2]	3.8	2.4	.3	.5	--	.6
Total[1]	634.1	262.8	226.7	8.9	119.6	16.0
Hardwoods:						
Red alder	21.4	3.9	2.0	10.6	2.4	2.4
Tanoak	2.7	--	.3	--	1.0	1.3
Other hardwoods[3]	13.6	3.1	2.9	.1	4.3	3.2
Total[1]	37.7	7.0	5.3	10.8	7.7	6.9
All species[1]	671.7	269.8	232.0	19.7	127.3	22.7

---

[1] Totals may be off because of rounding.

[2] Includes knobcone pine, Port-Orford-cedar, and Alaska cedar.

[3] Includes bigleaf maple, madrone, golden chinkapin, Oregon ash, cottonwood, oaks, and California laurel (Oregon myrtle).

Table 20--*Timber harvest by ownership class, southwest Oregon, 1950-74*

(In thousand board feet, Scribner rule)

Year	All ownerships	Private	State	National Forest	Bureau of Land Manage.[1]	Other public
1950	2,653,927	[2]	2,392,627	252,300	--	9,000
1951	3,181,033	[2]	2,903,833	277,200	--	--
1952	3,887,385	[2]	3,616,585	270,800	--	--
1953	3,222,276	[2]	2,928,776	293,500	--	--
1954	3,550,143	[2]	3,151,343	398,800	--	--
1955	4,087,349	[2]	3,702,323	385,026	--	--
1956	3,498,667	[2]	2,821,526	398,000	279,141	--
1957	2,824,519	[2]	2,200,086	326,200	298,233	--
1958	2,873,112	1,990,426	11,549	480,037	391,100	--
1959	3,498,474	2,272,729	20,541	688,335	516,869	--
1960	3,244,003	2,256,604	29,061	511,721	446,617	--
1961	2,440,052	1,378,802	54,381	550,522	456,347	--
1962	2,922,115	1,570,415	52,796	705,300	593,604	--
1963	2,937,111	1,333,207	51,130	821,300	731,474	--
1964	3,283,185	1,462,333	92,730	892,000	836,122	--
1965	3,175,631	1,491,340	97,561	890,000	692,958	3,772
1966	2,994,991	1,486,372	79,145	763,700	660,461	5,313
1967	2,844,245	1,382,837	51,684	787,600	618,426	3,698
1968	3,236,433	1,471,202	38,561	889,052	833,194	4,424
1969	2,969,011	1,538,927	79,689	722,655	624,114	3,626
1970	2,583,868	1,353,710	58,582	608,270	556,500	6,806
1971	2,966,022	1,377,967	64,268	769,930	747,250	6,607
1972	3,165,962	1,405,344	63,911	969,799	722,298	4,610
1973	2,943,344	1,165,273	99,258	902,701	766,683	9,429
1974	2,692,159	1,302,454	99,040	699,262	580,626	10,777

---

[1] BLM figures prior to 1974 have been converted from short log to long log and may not agree with previously published figures.

[2] Separate data for private and State ownership not available.

ACCURACY OF CURRENT INVENTORY DATA

FOREST-LAND AREA AND TIMBER VOLUME

The estimates of forest-land area and timber volume in southwest Oregon for all owners other than National Forest and Bureau of Land Management were derived by sampling and consequently have sampling errors. Area and volume statistics for National Forests and BLM were updated with a stand projection model (Larson and Goforth 1970), and therefore, sampling errors were not computed. Since sampling intensities were greater on these lands, the accuracy of these inventories probably exceeded the accuracies shown below for the other owners.

Sampling errors have been computed for the estimates of commercial and noncommercial forest-land area, net cubic-foot volume of growing stock, and net board-foot volume (International 1/4-inch scale) of sawtimber. These sampling errors are presented in table 21 as a percent of the estimated total at 68- and 95-percent probability. They may be interpreted as meaning that the odds are two out of three for 68-percent probability, or 19 out of 20 for 95-percent probability, and that the ranges shown include the true value (i.e., the results of a 100-percent inventory). For example, we can expect, with 95-percent confidence, that the estimate of total commercial forest-land area--2,781,000 acres ± 3.1 percent (86,211 acres)--includes the true value.

In addition to measurable sampling errors, there may be other nonsampling errors caused by mistakes in judgment, measurement, and compilation. The magnitude of errors from these sources cannot be determined. Such errors are controlled by training, supervising, and field checking of field crews, and complete editing when compiling the data.

The sampling error of any breakdown of these totals will be substantially greater than the sampling error for the total; the smaller the breakdown, the larger the sampling error. An approximation of the increasing sampling error can be obtained from table 22, which shows the sampling error associated with smaller estimates.

Table 21--*Sampling error of estimate of forest area and timber volume, other than National Forest and Bureau of Land Management ownerships, southwest Oregon, January 1, 1975*

Item	Estimated total	Sampling error in percent	
		68-percent probability	95-percent probability
Commercial forest land	2,781,000 acres	± 1.6	± 3.1
Noncommercial forest land	251,000 acres	±13.3	±26.1
Volume			
Growing stock	6,725 million cubic feet	± 5.8	± 7.8
Sawtimber (International 1/4-inch rule)	35,902 million board feet	± 7.1	±13.92

Table 22--*Approximate sampling error by size of area and volume, other than National Forest and Bureau of Land Management, southwest Oregon, January 1, 1975*

Commercial forest land		Noncommercial forest land		Growing stock		Sawtimber	
Area	Sampling error[1]	Area	Sampling error[1]	Volume	Sampling error[1]	Volume	Sampling error[1]
Thousand acres	Percent	Thousand acres	Percent	Million cubic feet	Percent	Million board feet[2]	Percent
4,000	1.3	400	10.5	8,000	5.3	36,000	7.1
2,000	1.9	200	14.9	6,000	6.1	34,000	7.3
1,000	2.7	100	21.1	4,000	7.5	32,000	7.5
800	3.0	50	29.8	2,000	10.63	30,000	7.8
600	3.4	25	42.1	1,000	15.0	25,000	8.5
400	4.2	10	66.6	800	16.8	20,000	9.5
200	6.0	5	94.2	600	19.4	10,000	13.5
100	8.4	3	121.7	400	23.8	5,000	19.0
50	11.9	1	210.7	200	33.6	1,000	42.5
25	16.7			100	47.6	800	47.6
10	26.7			50	67.3	600	54.9
5	37.7			25	95.1	400	67.3
3	48.7			10	150.4	200	95.1
1	84.4					100	134.5
						50	190.3
						25	269.1
						10	425.4

[1] By random sampling formula; 68-percent probability.

[2] International 1/4-inch rule.

INVENTORY PROCEDURES

This report of southwest Oregon's forest resources combines data from six National Forest inventories, four BLM inventories, and an inventory of the private, State, county, and municipal lands conducted by the Renewable Resources Evaluation Work Unit of the Pacific Northwest Forest and Range Experiment Station. All volumes for the BLM inventories and for five of the National Forest inventories have been updated to 1974 to account for cut, reforestation, growth, and mortality since the dates of inventory. Table 23 summarizes the various inventories.

NATIONAL FOREST AND BLM

The National Forest (except the Klamath) and BLM inventories were all simple systematic samples with field plots distributed on a square grid. For all forests except the Willamette, the volume, area, and growth data were expanded from field plots, with each plot having equal weight.

On the Willamette National Forest, nonforest, noncommercial forest, and clearcut areas were mapped and the field sample was restricted to commercial forest land, exclusive of clearcuts. Inventory data on clearcuts came from forest records based on plantation and compartment examinations.

The Siuslaw National Forest inventory consisted of three 1/5-acre plots established at each field location. For the other National Forest and BLM inventories, each field plot consisted of a cluster of 10 variable-radius points sampling an acre. Seedlings and saplings were sampled on small fixed-radius plots located at each of the 10 points.

The Klamath National Forest was sampled by a double sampling design. Photo points, distributed over the entire forest, were classified to stratify the land into commercial, noncommercial, and nonforest land

Table 23--*Summary of inventories in southwest Oregon*

Inventories	Number of field plots	Field plot grid	Inventory date	Area updated to--	Volume updated to--
		Miles			
Bureau of Land Management Districts:					
Coos Bay	302	1.2	1968	1974	1974
	71	.85	1968	1974	1974
Eugene	21	1.2	1968	1973	1974
Medford	512	1.7	1966	1974	1974
Roseburg	428	1.2	1969	1973	1974
National Forests:					
Klamath	25	random selection	1967	--	1974
Rogue River	[1]248	1.7	1967	1973	1974
Siskiyou	[1]400	1.7	1967	1974	1974
Siuslaw	[1] 29	1.7	1963	1973	1974
Umpqua	463	1.7	1968	1973	1974
Willamette	23	1.7	1971	--	--
Private, State, county and municipal lands:					
Douglas County, timber zone	141	3.4	1973	--	--
Douglas County, agriculture zone	27	6.8	1973	--	--
Coos, Curry, Jackson, and Josephine Counties	344	3.4	1974	--	--

[1] Commercial forest land.

classes. Commercial photo points were further stratified into volume classes. A random sample of field plots was selected, proportional to the photo points in each land and volume class.

For all but the Willamette National Forest inventory, growth, and mortality were updated by stand projection (Larson and Goforth 1970). In addition, all plots cut since inventory were identified and assigned new area classifications based on data furnished by the BLM and the U.S. Forest Service.

PRIVATE AND OTHER PUBLIC LANDS

The sampling design used was double sampling for stratification (Cochran 1963). Approximately 8,300 photo points were classified by: (1) owner group; (2) major land class (commercial forest, noncommercial forest, and nonforest); and (3) stand volume class. In addition, the inventory in Douglas County was divided into two zones: the timber and agricultural zones. Permanent field plots were remeasured on a 3.4-mile grid in the timber zone and on a 6.8-mile grid in the agricultural zone. Field plot weights were calculated separately for each owner-land class-volume stratum for each zone. In Coos, Curry, Jackson, and Josephine Counties there was only one zone; field plot weights were calculated separately for each owner-land class-volume stratum. A total of 41 supplemental plots were added so that there were at least 2 field plots for each stratum.

As with the National Forest and BLM inventories, each field plot in this inventory consisted of a cluster of 10 variable-radius points sampling an acre. However, unlike those inventories, most plots were originally established in 1962 and were remeasured for this inventory. Growth and mortality were estimated from comparisons of old tree tallies with current tallies on remeasurement plot and from increment cores and ocular mortality estimates on supplemental plots.

DEFINITION OF TERMS

Land Area

Total land area is that reported by the Bureau of the Census: Total land area includes dry land and land temporarily or partially covered by water, such as marshes, swamps, and river flood plains; streams, sloughs, and canals less than one-eighth mile wide; and lakes, reservoirs, and ponds less than 40 acres in area.

Forest land is land at least 10 percent stocked by live trees or land formerly having such tree cover and not currently developed for nonforest use. Minimum area of forest land recognized is 1 acre.

Nonforest land is land that has never supported forests or land that was formerly forested and is currently developed for nonforest uses. Included are lands used for agricultural crops, improved pasture, residential areas, city parks, improved roads, and operating railroads and their right-of-way clearings, powerline and pipeline clearings, and 1- to 40-acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and other nonforest strips must be more than 120 feet wide, and clearings, etc., more than 1 acre in size, to qualify as nonforest land.

Forest-land Classes

Commercial forest land is land capable of producing 20 cubic feet per acre per year of industrial wood and is not withdrawn from timber utilization.

Deferred forest land is productive land that has been administratively identified for study as possible additions to the Wilderness System or other withdrawal from timber utilization.

Noncommercial forest land is land incapable of yielding crops of industrial wood because of adverse site conditions, or it is productive public forest land withdrawn from commercial timber use through statute or administrative regulation.

Productive-reserved forest land is public land withdrawn from timber utilization through statute, ordinance, or administrative order but which otherwise qualifies as commercial forest land.

Unproductive forest land is land incapable of yielding crops of industrial wood products because of adverse site conditions such as sterile soils, poor drainage, high elevation, steepness, and rockiness.

Forest Types

Stands with 50 percent or more stocking in live conifer trees are called softwood types. Stands with a majority of stocking in live hardwood trees are classed as hardwood types. Within these two type groups, the individual forest type is determined by plurality of stocking by species of live softwood or hardwood trees.

Tree Classes

Growing Stock

Growing stock trees are live trees of commercial species which meet the minimum merchantability standards for sawtimber, poletimber, or seedling and sapling trees.

Sawtimber trees are growing stock trees at least 9.0 inches in d.b.h. if they are softwoods and at least 11.0 inches in d.b.h. if they are hardwoods. At least 25 percent of the board-foot volume in a sawtimber tree must be free from defect. Softwood trees must contain at least one 12-foot saw log with a top diameter of not less than 6 inches inside the bark; hardwood trees must contain at least one 8-foot saw log with a top diameter of not less than 8 inches inside the bark.

Poletimber trees are growing stock trees 5.0 to 8.9 inches in d.b.h. if they are softwoods and 5.0 to 10.9 inches in d.b.h. if they are hardwoods with a cubic-foot volume of wood at least 50 percent free from defect. They are free from any disease, defect, or deformity which is likely to prevent their becoming sawtimber trees.

Sapling and seedling trees are growing stock trees less than 5.0 inches in d.b.h. that have no disease, defects, or deformities likely to prevent their becoming growing stock poletimber trees.

Nongrowing Stock

Cull trees are noncommercial species or commercial species which are too defective or which are unlikely to become growing stock trees because of deformity, disease, log vigor, etc.

Sound cull trees are noncommercial species or commercial species with excessive defect caused by form, roughness, etc.

Rotten cull trees have excessive defect primarily caused by rot.

Mortality trees are commercial species which died from natural causes within a specified period and which were growing stock trees at the time of death.

Salvable dead trees are standing or down trees of commercial species, 9.0 inches or more in diameter for softwoods and 11.0 inches or more in diameter for hardwoods, containing 25 percent or more of sound volume and at least one merchantable 16-foot log if softwood or one merchantable 8-foot log if hardwood.

Stand-size Classes

Sawtimber stands are at least 10 percent stocked with growing stock trees, with half or more of this stocking in sawtimber and poletimber trees and with sawtimber stocking equal to or greater than poletimber stocking. In *large sawtimber stands,* the majority of the sawtimber stocking is in trees 21.0 inches and larger at breast height. In *small sawtimber stands,* the majority of the sawtimber stocking is in trees from 9.0 to 20.9 inches at breast height.

Poletimber stands are at least 10 percent stocked with growing stock trees, with half or more of this stocking in sawtimber and poletimber trees, and with poletimber stocking exceeding sawtimber stocking.

Sapling and seedling stands are at least 10 percent stocked with growing stock trees, with more than half of this stocking in saplings, seedlings, or both.

Nonstocked areas of commercial forest land are less than 10 percent stocked with growing stock trees.

Stocking

Stocking is a measure of how well the productive potential of the site is being utilized by trees. For stands with a mean d.b.h. of at least 8 inches, the measure of stocking is relative density expressed as a percent of normal stocking; i.e., the current number of trees per acre expressed as a percent of the normal number indicated for a stand of the same mean diameter and species. For stands with a mean diameter of less than 8 inches, stocking does not indicate the current level of site utilization but instead suggests the degree of site utilization that is expected when the stand reaches 8 inches in mean diameter. For such stands, the stocking standard is the normal number of trees for an 8-inch stand, discounted for expected mortality. In stands of mixed size and species, the density standard used is a weighted average for the various species and sizes of trees present.

Timber Volume

Live Sawtimber

Net volume of live sawtimber trees of commercial species is measured in board feet. Net volume equals gross volume less deduction for rot, sweep, crook, and other defects that affect use for lumber.

Scribner rule is the common board-foot log rule used locally in determining volume of sawtimber. Scribner volume is measured in terms of 32-foot logs.

International 1/4-inch rule is the standard board-foot log rule adopted nationally by the Forest Service for the presentation of Renewable Resources Evaluation volume statistics.

Saw-log portion is the bole of sawtimber trees between the stump and the saw-log top.

Upper-stem portion includes the bole of sawtimber trees above the saw-log top of 7.0 inches outside bark for softwoods and 8.0 inches outside bark for hardwoods to a minimum top diameter of 4.0 inches outside bark, or to the point where the central stem breaks into limbs.

Growing Stock

Net volume of growing stock is measured in cubic feet of live sawtimber trees and live poletimber trees from stump to a minimum 4.0-inch top (of central stem) outside bark. Net volume equals gross volume less deduction for rot and missing bole sections.

All Timber

All timber includes the net volume in cubic feet of live growing-stock poletimber and sawtimber trees and salvable dead sawtimber trees of commercial species and the gross volume in cubic feet of cull trees of all species. Volume is measured from stump to a minimum 4.0-inch top outside bark.

Net Annual Growth

Components of net annual growth include: (a) the increment in net volume of trees at the beginning of the specified year surviving to the year's end plus (b) the net volume of trees reaching the size class during the year minus (c) the net volume of trees that died during the year minus (d) the net volume of trees that became culls during the year.

Ownership Classes

National Forest lands are Federal lands which have been designated by Executive order or statute as National Forests or purchase units and other lands under the administration of the Forest Service, including experimental areas and Bankhead-Jones title III lands.

Other public lands are Federal lands other than National Forests or lands administered by the Bureau of Land Management and lands owned by States, counties, and local public agencies or leased by these governmental units for more than 50 years.

Forest industry lands are lands owned by companies or individuals operating wood-using plants.

Other private lands include all private lands except those classed as forest industry lands.

Miscellaneous Definitions

A *short log* is a standard 16-foot log.

A *long log* is a standard 32-foot log.

Plantation examination is the examination of an artificially reforested area established by planting or direct seeding.

Compartment examination is the examination of a small subdivision of forest area defined by permanent boundaries and used for orientation, administration, and silvicultural operations.

PLANT SPECIES

This list includes the important tree species occurring in southwest Oregon. The source for scientific names is Little (1953).

Scientific name	Common name
Softwood trees:	
Abies amabilis (Dougl.) Forbes	Pacific silver fir
Abies concolor (Gord. & Glend.) Lindl.	white fir
Abies grandis (Dougl.) Lindl.	grand fir
Abies lasiocarpa (Hook.) Nutt.	subalpine fir
Abies magnifica var. *shastensis* Lemm.	Shasta red fir
Abies procera Rehd.	noble fir
Chamaecyparis lawsoniana (A. Murr.) Parl.	Port-Orford-cedar
Chamaecyparis nootkatensis (D. Don) Spach	Alaska-cedar
Juniperus occidentalis	western juniper
Libocedrus decurrens	incense-cedar
Picea breweriana S. Wats.	Brewer spruce
Picea engelmannii Parry	Engelmann spruce
Picea sitchensis (Bong.) Carr.	Sitka spruce
Pinus albicaulis Engelm.	whitebark pine
Pinus attenuata Lemm.	knobcone pine
Pinus contorta Dougl.	lodgepole pine
Pinus jeffreyi Grev. & Balf.	Jeffrey pine
Pinus lambertiana Dougl.	sugar pine
Pinus monticola Dougl.	western white pine
Pinus ponderosa Laws.	ponderosa pine
Pseudotsuga menziesii (Mirb.) Franco	Douglas-fir
Sequoia sempervirens (D. Don) Engl.	redwood
Thuja plicata Donn	western redcedar
Tsuga heterophylla (Raf.) Sarg.	western hemlock
Tsuga mertensiana (Bong.) Carr.	mountain hemlock
Hardwood trees:	
Acer macrophyllum Pursh	bigleaf maple
Alnus rhombifolia Nutt.	white alder
Alnus rubra Bong.	red alder
Arbutus menziesii Pursh	Pacific madrone
Castanopsis chrysophylla Dougl. A. DC.	golden chinkapin

Fraxinus latifolia Benth.	Oregon ash
Lithocarpus densiflorus (Hook. & Arn.) Rehd.	tanoak
Populus trichocarpa Torr. & Gray	black cottonwood
Quercus chrysolepis Liebm.	canyon live oak
Quercus garryana Dougl.	Oregon white oak
Quercus kelloggii Newb.	California black oak
Umbellularia californica (Hook. & Arn.) Nutt.	California-laurel (Oregon myrtle)

LITERATURE CITED

Cochran, W. G.
1963. Sampling techniques. 2d ed., 413 p. John Wiley & Sons, Inc., New York.

Larson, Robert W., and Marcus H. Goforth.
1970. TRAS, a computer program for the projection of timber volume. U.S. Dep. Agric., Agric. Handbk. 377, 24 p., illus.

Little, Elbert L., Jr.
1953. Check list of native and naturalized trees of the United States (including Alaska). U.S. Dep. Agric., Agric. Handbk. 41, 472 p.

G ERNMENT PRINTING OFFICE: 1977—797-849/138 REGION 10

Bassett, Patricia M.
1977. Timber resources of southwest Oregon.
USDA For. Serv. Resour. Bull. PNW-72,
29 p. Pacific Northwest Forest and
Range Experiment Station, Portland,
Oregon.

This report presents statistics from a 1973 inventory of timber resources of Douglas County and from a 1974 inventory of timber resources of Coos, Curry, Jackson, and Josephine Counties, Oregon. Tables presented are of forest area and of timber volume, growth, and mortality.

KEYWORDS: Forest surveys, statistics (forest), resources (timber), Oregon (southwest).

Bassett, Patricia M.
1977. Timber resources of southwest Oregon.
USDA For. Serv. Resour. Bull. PNW-72,
29 p. Pacific Northwest Forest and
Range Experiment Station, Portland,
Oregon.

This report presents statistics from a 1973 inventory of timber resources of Douglas County and from a 1974 inventory of timber resources of Coos, Curry, Jackson, and Josephine Counties, Oregon. Tables presented are of forest area and of timber volume, growth, and mortality.

KEYWORDS: Forest surveys, statistics, (forest), resources (timber), Oregon (southwest).

Bassett, Patricia M.
1977. Timber resources of southwest Oregon.
USDA For. Serv. Resour. Bull. PNW-72,
29 p. Pacific Northwest Forest and
Range Experiment Station, Portland,
Oregon.

This report presents statistics from a 1973 inventory of timber resources of Douglas County and from a 1974 inventory of timber resources of Coos, Curry, Jackson, and Josephine Counties, Oregon. Tables presented are of forest area and of timber volume, growth, and mortality.

KEYWORDS: Forest surveys, statistics (forest), resources (timber), Oregon (southwest).

Bassett, Patricia M.
1977. Timber resources of southwest Oregon.
USDA For. Serv. Resour. Bull. PNW-72,
29 p. Pacific Northwest Forest and
Range Experiment Station, Portland,
Oregon.

This report presents statistics from a 1973 inventory of timber resources of Douglas County and from a 1974 inventory of timber resources of Coos, Curry, Jackson, and Josephine Counties, Oregon. Tables presented are of forest area and of timber volume, growth, and mortality.

KEYWORDS: Forest surveys, statistics (forest), resources (timber), Oregon (southwest).

The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Developing and evaluating alternative methods and levels of resource management.
3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research are made available promptly. Project headquarters are at:

Fairbanks, Alaska
Juneau, Alaska
Bend, Oregon
Corvallis, Oregon
La Grande, Oregon
Portland, Oregon
Olympia, Washington
Seattle, Washington
Wenatchee, Washington

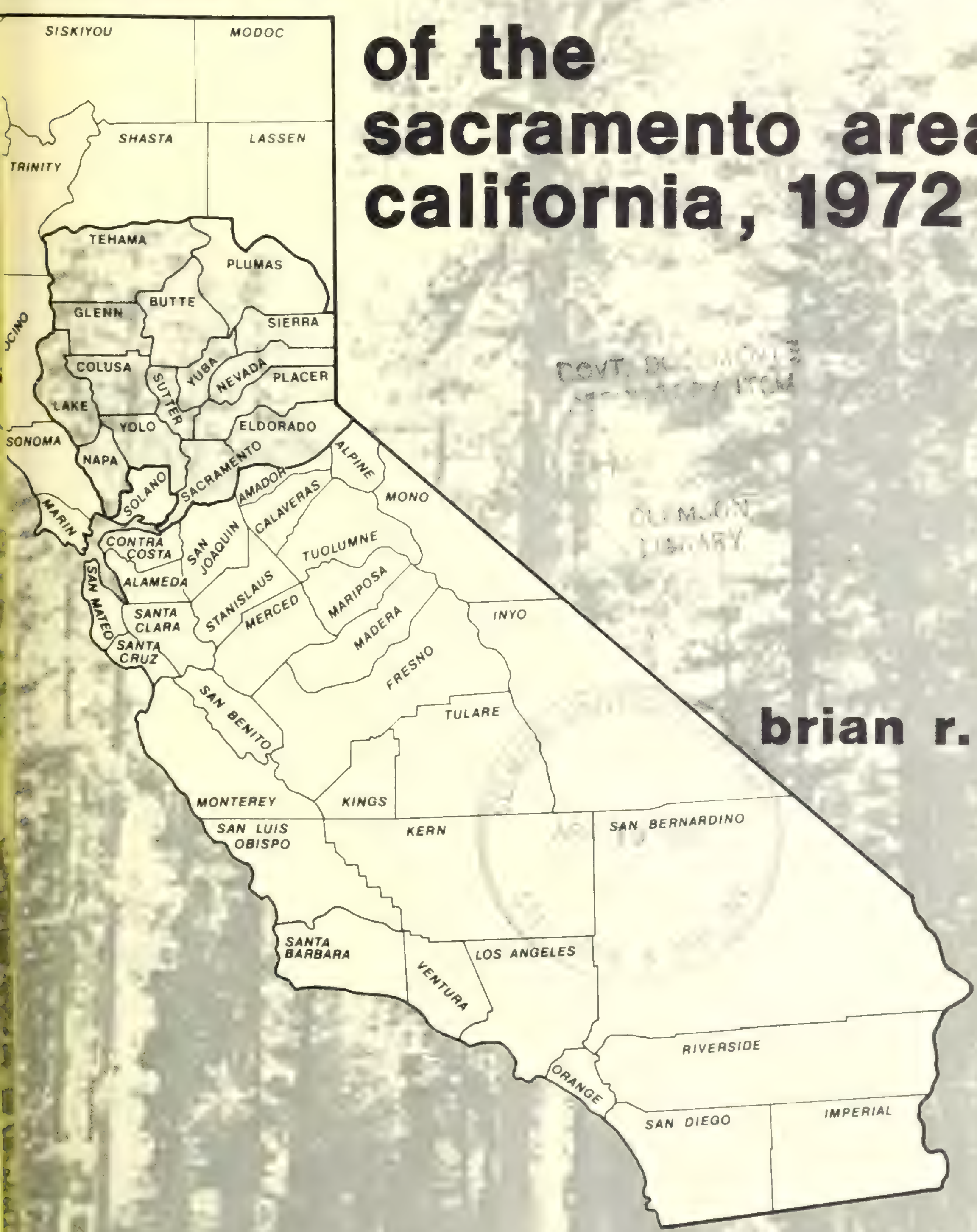
Mailing address: Pacific Northwest Forest and Range
Experiment Station
P.O. Box 3141
Portland, Oregon 97208

The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

The U.S. Department of Agriculture is an Equal Opportunity Employer. Applicants for all Department programs will be given equal consideration without regard to race, color, sex or national origin.

USDA Forest Service Resource Bulletin PNW-73
1978

timber resources of the sacramento area, california, 1972



GOVT. DOCUMENTS
DEPOSITORY ITEM

CLEMSON
LIBRARY

brian r. wall

acific Northwest
orest and Range Experiment Station
S. Department of Agriculture
orest Service Portland, Oregon

METRIC CONVERSIONS

1,000 acres = 404.69 hectares
1,000 cubic feet = 28.3 cubic meters
1 cubic foot per acre = 0.070 0 cubic meters per hectare
1 square foot basal area per acre = 0.229 6 square meters per hectare
1 foot = 30.48 centimeters

CONTENTS

Page

THE SETTING 1

FOREST AREA 3
  Forest ownership. 7
  Timber production restrictions on National Forest lands 8
  Timber production restrictions on private and other public lands 9
  Changes in ownership and area of commercial forest land 11
  White fir (most common type) 13
  Sawtimber stands dominate resource area 14
  Stocking high on private lands. 14

TIMBER VOLUME 14
  Timber volume change. 16

TIMBER GROWTH, CUT, AND MORTALITY 16

FOREST INDUSTRY 20
  Forest-based employment 20

INVENTORY PROCEDURES. 21
  Reliability of forest resource estimates. 23

DEFINITION OF TERMS 23
  Land area 23
  Forest land classes 24
  Forest types. 24
  Tree classes. 24
  Nongrowing stock. 25
  Stand size classes. 25
  Stocking 26
  Timber volume 26
  Ownership classes 27

APPENDIX I 28

LITERATURE CITED. 29

APPENDIX II 31

TIMBER RESOURCES OF THE SACRAMENTO AREA, CALIFORNIA, 1972

Reference Abstract

Wall, Brian R.
1978. Timber Resources of the Sacramento Area, California, 1972. USDA For. Serv. Resour. Bull. PNW-73, 62 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report summarizes the 1972 timber resource inventory of the Sacramento area, California. Included are detailed tables of forest area, timber volume, growth, mortality, and timber cut and a discussion of the current timber resource and timber industry situation.

KEYWORDS: Forest surveys, statistics (timber), timber statistics, resources (timber), timber resources, California (Sacramento area), Sacramento area--California.

RESEARCH SUMMARY

Resource Bulletin PNW-73

1978

California's Sacramento area has 13 percent of the State's total land area and 6 percent of the State's population. The area is largely rural with the population concentrated in the Sacramento valley between the timbered and sparsely populated Coast Range to the west and the Sierra Nevada Range to the east.

Forest land totals 7 million acres with about 4 million acres of commercial forest land capable of growing crops of timber, 3 million acres of unproductive forest land, and 71,000 acres of productive forest land which is reserved from timber harvesting in parks and wilderness areas. National Forests have 54 percent of the commercial forest land, forest industries 17 percent, farm and miscellaneous private owners 27 percent and other public owners 2 percent.

Since 1953 the loss of commercial forest land to other uses has been small. About 35,000 acres of commercial forest land has been converted to powerlines and other uses. Increasing recreational demands have resulted in the conversion of 16,000 acres of commercial forest land to parks and wilderness areas. A large difference in the area of commercial forest occurred because new methods of evaluating forest land productivity resulted in a reclassification of 330,000 acres to noncommercial forest.

The volume of growing stock is 13 billion cubic feet and sawtimber 65 billion board feet (Scribner). National Forests have 64 percent of the sawtimber volume, forest industries 18 percent, and farm and miscellaneous private owners 17 percent.

White fir is the most important forest type in the resource area. Other important types are ponderosa pine, Douglas-fir, incense-cedar, red fir, and sugar pine.

Private forest lands are generally well stocked with conifers. About three-fifths of the total commercial area in private ownership is at least 60 percent stocked with conifers. This level of stocking is generally considered adequate for realizing the growth potential of the land.

Total net annual growth is 205 million cubic feet (1 billion board feet). Forest industry has the highest net annual growth with 63 cubic feet per acre. Farm and miscellaneous private and National Forests grow about 50 cubic feet per acre per year. Annual mortality is relatively low, amounting to only 33 million cubic feet. National Forest mortality as a percent of the inventory is less than the average for all owners.

The annual timber harvest for the area is about 1 billion board feet. This level of timber harvest has been maintained since the late 1940's with National Forests currently accounting for 65 percent. Most of the harvest is pines although the inventory runs heavily to true firs. This heavy cutting in pines will eventually shift the species mix even more heavily to fir.

The forest industry employs about 9,000 people. Lumber is the principal product. Veneer, plywood, and pulp are also manufactured in 44 primary processing plants located in the area.

THE SETTING

The Sacramento resource area contains 15 counties (fig. 1). Within the area is Sacramento, the State capital; several other population centers which are also processing centers for agricultural and forest products; portions of seven National Forests; numerous recreational attractions

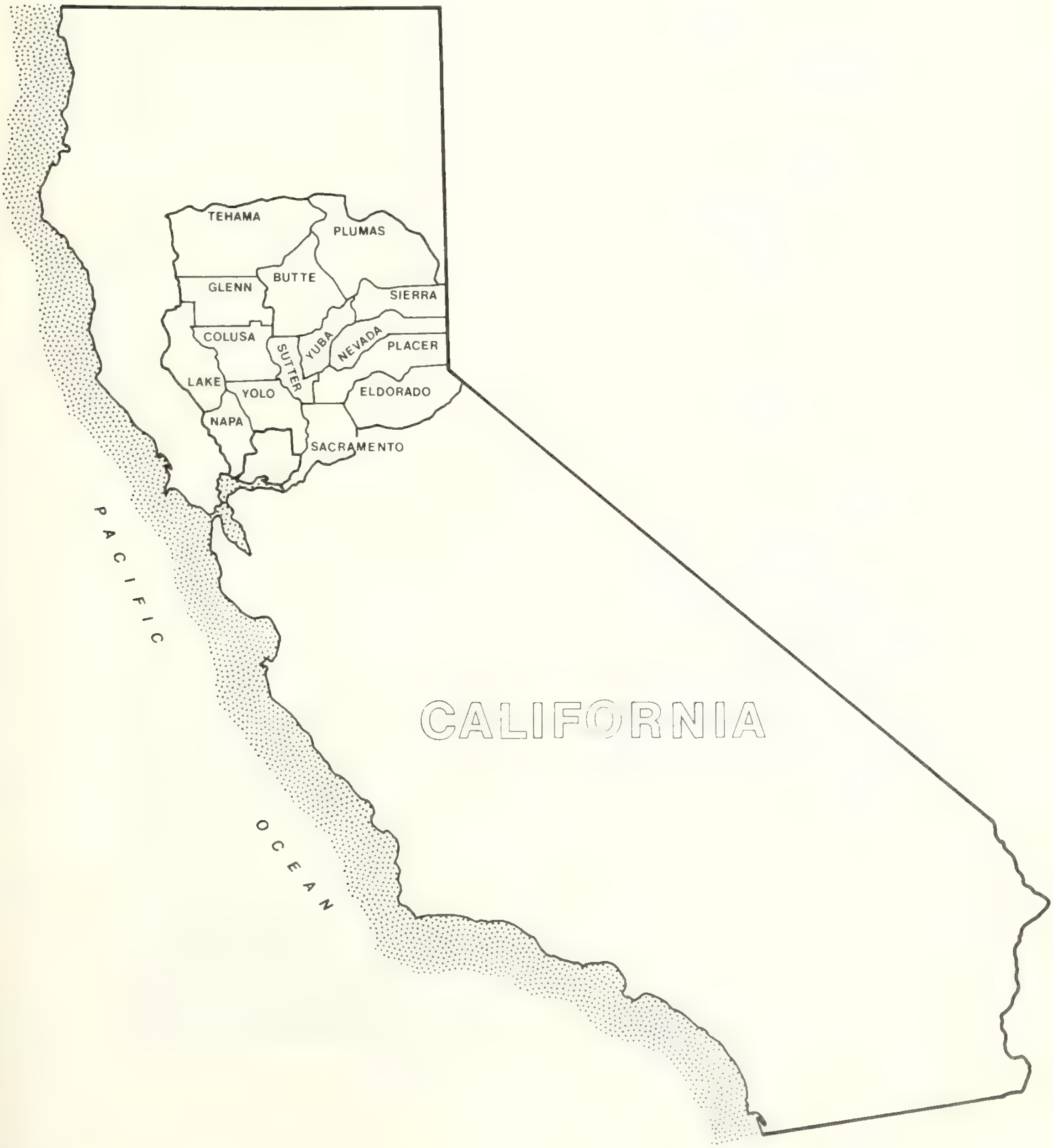


Figure 1.--Counties of the Sacramento area.

including Lake Tahoe and Squaw Valley; fast-water rivers; the historic mother lode gold country; and a part of the extremely productive Central Valley.

The land area totals 12.8 million acres, or 13 percent of the State's total, and currently has a population of 1.4 million people, 6.5 percent of the State's total. The area is largely rural, with 70 percent of the population living in Sacramento County and the 25 largest towns and cities, most of which are located in the Sacramento Valley and the western foothills of the Sierra Nevada. Large areas are scantly populated, including the east slope of the Coast Range in Colusa, Glenn, and Tehama Counties and the mountainous lands in much of the Sierra Nevada.

The Sacramento resource area is dominated by the Sacramento Valley, drained by California's largest river, the Sacramento. The nearly flat alluvial plain is one of the most productive agricultural regions in the United States. The Sierra Nevada mountain range is located on the eastern side of the valley. On the west side is the Coast Range which roughly parallels the Sierra Nevada Range. The valley receives the easterly drainage from the Coast Range and the westerly drainage from the Sierra Nevada Range.

The dry, barren foothills of the Coast Range are isolated and sparsely populated (fig. 2). Timber at the higher elevations supports logging and sawmilling.

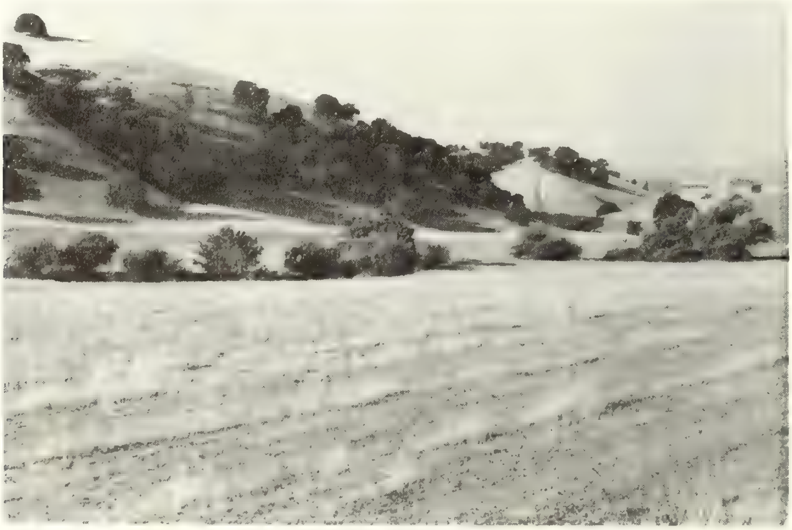


Figure 2.--Oak savanna in the Coast Range of Glenn County provides food and shelter for wildlife and domestic livestock.

The Sacramento resource area has long hot summers and rainy winters. The counties in the high Sierra Nevada receive heavy snowfall during the winter months, while in the valley heavy nighttime fog is common. In the spring and early summer, the melting snow runoff on western slopes feeds underground water supplies, rivers, and irrigation systems. Water is essential to the Central Valley's multibillion dollar agricultural industry.

Lake Tahoe Basin is located on the east slope of the Sierra's. Its area is about 500 square miles, including the 192 square mile Lake Tahoe. This area was heavily logged between 1860 and 1900 when demand for lumber in the Nevada silver mines was high.

The Tahoe basin is a vacation haven for Californians from San Francisco and the Sacramento areas. With gaming on the Nevada side of the basin and skiing on the mountain slopes, the basin is a vacation spot with year-round appeal. With summer population rising to 150,000, the land receives increased pressures. As a consequence, environmental degradation is a major concern to the two State governments, the five county governments, and the Federal Government which owns 62 percent of the basin's land area. National Forests make up the Federal ownership.

FOREST AREA

The Sacramento area is about 60 percent forested. At the lower elevations, forest land first occurs in stringers along streams in the Sacramento Valley. Where these stringers have productive commercial hardwoods--mainly black cottonwood--and are of sufficient area (1 acre and 120 feet wide), they are classed as commercial forest land. If the area is too low in productivity, it is classed as noncommercial forest land. Noncommercial species found in the valley and the foothills include California sycamore, willow, California white oak, blue oak, and canyon live oak. In the foothills, Digger pine is sometimes mixed with the oak and chaparrel covers a large area, grading into oaks at lower elevations or pines and firs at higher elevations. Chaparrel commonly consists of manzanita, ceanothus, chamise, or scrub oak.

Many areas of both chaparrel and oak woodlands are being cleared for grazing (figs. 3 and 4).

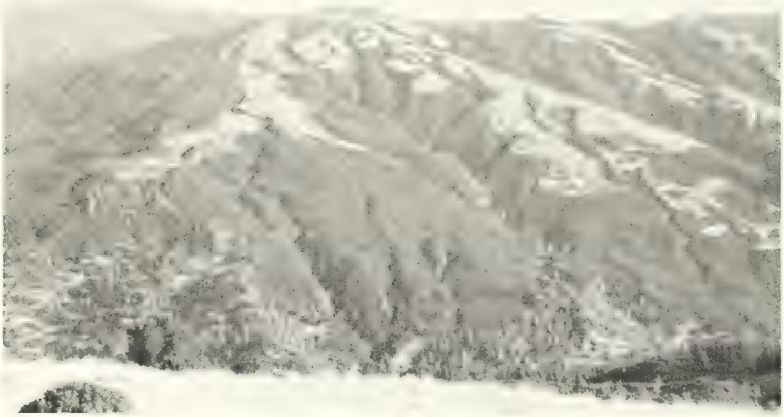


Figure 3.--The chamise fields of the Coast Range foothills in Glenn County are dry and isolated. The chamise in the picture is being cleared.

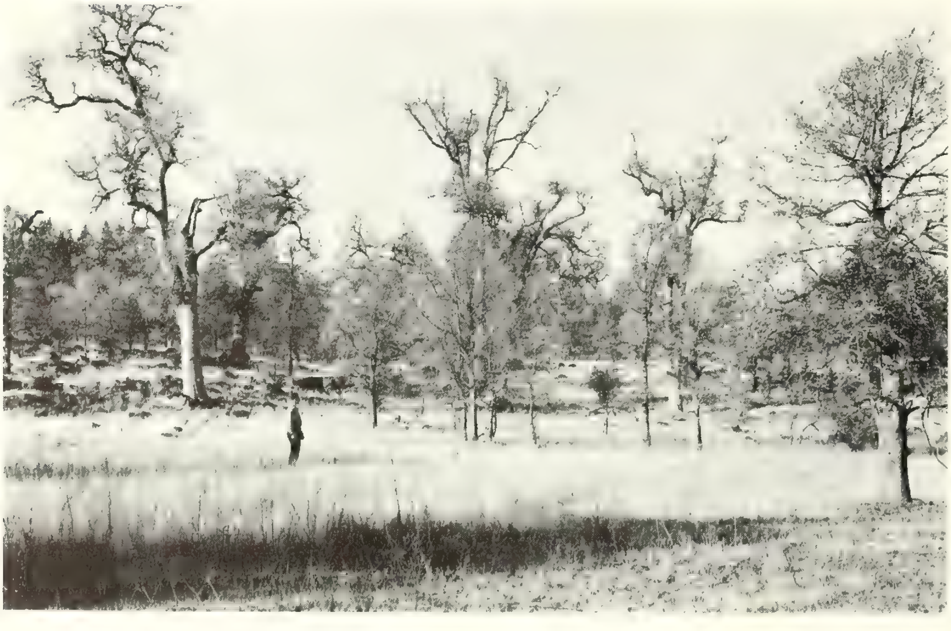


Figure 4.--Oak woodlands occur on thousands of acres of noncommercial forest land.

Commercial forest land in fairly large contiguous areas first occurs above the foothills in stands of ponderosa pine with inclusions of chaparrel which originated on burned forested areas. Ponderosa pine occurs in pure stands or mixed with California black oak and other hardwoods at lower elevations. With increasing elevation, ponderosa pine is found with Douglas-fir, sugar pine, and white fir grading into white fir and then to red fir.

A substantial amount of the forested area is in mixed conifer associations composed of ponderosa pine, Douglas-fir, white fir, sugar pine, and incense-cedar. Jeffrey pine appears on a broad range of elevations on the east side of the Sierra Nevada. Past history of man's use of the land has altered these forest associations and change is continuing (figs. 5 and 6).

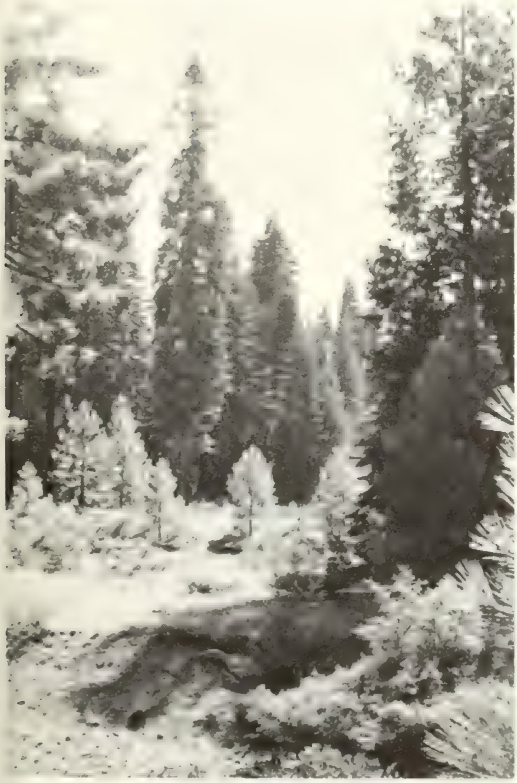


Figure 5.--Mixed ages and mixed species are most common in the Sacramento resource area. Ponderosa pine reproduction is common to planted sites as well as natural open stands. This area is not fully stocked.

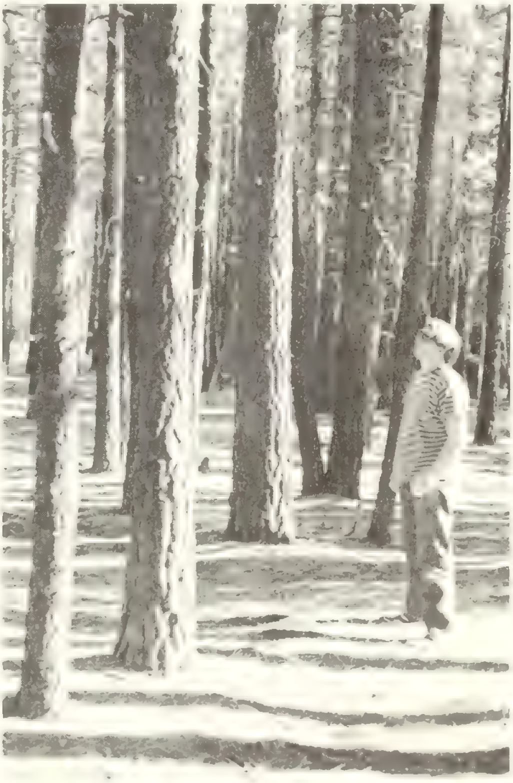


Figure 6.--A young-growth stand of Jeffrey pine near Truckee in Nevada County.

The Sacramento resource area has 7.5 million acres of forested land located along the Coast Range and the Sierras. Commercial forest land in the area amounts to 3.9 million acres, 23 percent of the State's total. Commercial forest occurs mainly at higher elevations where moisture is not a limiting factor to tree growth. This land is capable of growing at least 20 cubic feet of wood per acre per year.

Counties with the greatest concentrations of commercial forest land are located in the Sierra Nevada Range. These heavily timbered counties have been subjected to a long history of timber use dating back to the gold rush days. As a result there are many young-growth stands of timber, both unevenaged and evenaged (fig. 7).

There are 3.4 million acres of forest land that are unproductive for timber production in the eastern foothills of the Coast Range and the western foothills of the Sierra Nevada. This substantial forest area is important for grazing, wildlife, and watershed. The west side of the Sacramento resource area has vast, isolated, unproductive forest lands in Tehama, Lake, and Napa Counties. Many of these areas are being converted to grazing. This is accomplished by chemical, and mechanical methods and burning. Thousands of acres are treated each year and many of the acres are seeded with grass.

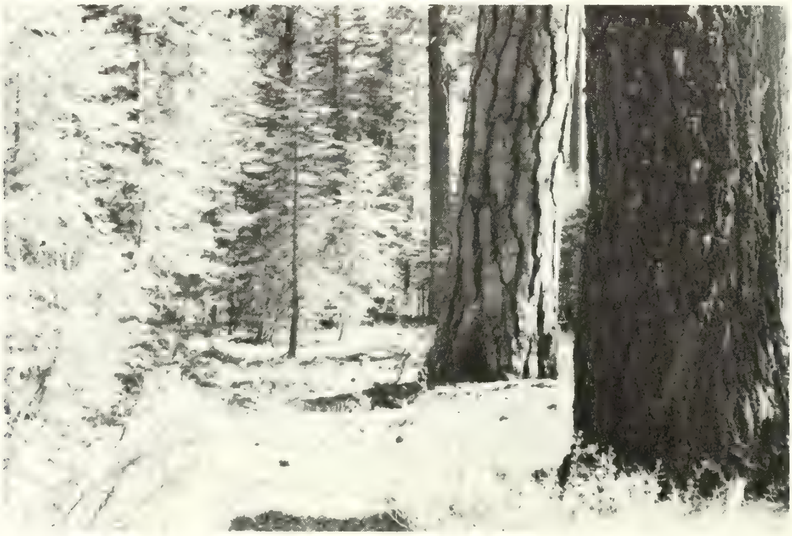


Figure 7.--An unevenaged stand of white fir and ponderosa pine in Plumas County.

About 71,000 acres of productive forest land in the Sacramento resource area are reserved from timber harvesting by law. The two largest areas are the Yollo Bolly Wilderness in Tehama County, and the Desolation Wilderness in El Dorado

County. Of the total productive reserved area, the National Forests account for 60 percent, National Parks 23 percent, and 17 percent are in State and county parks, Nature Conservancy, and other lands. The Wilderness System of the National Forests could increase in the future because some roadless areas and some wilderness study areas are under consideration for inclusion in the Wilderness System.[1]

FOREST OWNERSHIP

The following tabulation shows the percentage of commercial forest land by ownership:

Owner	Percent
National Forest	54
Other public	2
Forest industry	17
Farmer owned	6
Miscellaneous private corporate	10
Miscellaneous private noncorporate	11
Total	100

The National Forests are the largest landowner with 2.1 million acres of commercial forest land. All or part of the following National Forests are in the area: Mendocino and Trinity in the Coast Range; the Plumas, Tahoe, Eldorado, Lassen, and Toiyabe in the Sierra Nevada. National Forests are managed for wildlife, forage, recreation, water, and timber; on lands with unique characteristics one or more of these land uses may be stressed. For instance, on the Eldorado and Tahoe National Forest within the Lake Tahoe Basin, recreation and water uses are stressed, whereas on the Mendocino National Forest water, timber, and wildlife are paramount.

There are 1.7 million acres of private commercial forest land in the Sacramento resource area. Forest industries own 653,000 acres of commercial forest with most of these lands in Tehama, Butte, and Plumas Counties. The largest forest industry landowners are Diamond International, Louisiana Pacific, Collins Pine, American Forest Products, Crane Mills, and Michigan-California Forest Industries. These six companies account for 72 percent of the land owned by forest industry.

---

[1] At the time of the inventory there were no wilderness study areas, but current statistics show 2,100 acres of commercial forest land in a wilderness study area on the Tahoe National Forest and 19,000 acres in the Mendocino National Forest.

There are 406 thousand acres of commercial forest owned by corporations included in the aggregate ownership group "farm and miscellaneous." A number of these corporations are large landowners although they do not own a primary conversion plant and thus are not identified as forest industry. In terms of management objectives they are similar to forest industry owners. Corporate owners usually managed their lands for long term objectives. This provides the stability necessary for timber management. This category includes such owners as Southern Pacific Land Company, Soper-Wheeler, Pacific Gas and Electric Company, Chy Corporation, and the old Shafco properties managed by W. M. Beaty and Associates, Inc. These five companies account for 59 percent of the miscellaneous private corporate land in the Sacramento area.

Farmer and miscellaneous private noncorporate lands total 565 thousand acres.

TIMBER PRODUCTION RESTRICTIONS ON NATIONAL FOREST LANDS

Commercial forest land on National Forests is classified according to the capability of the land to satisfy land management plans. Seventy-two percent of the commercial forest land is classed as *standard*. This is land on which the site can be fully utilized for growing crops of industrial wood with adequate protection for forest resources (fig. 8).

Figure 8.--Commercial timber land in a view from Bucks Summit in Plumas County.

About 8 percent of the land is in a category termed *special* and includes lands under landscape management or travel influence and water influence zones. On these lands, consideration of other resource values may reduce timber yields. Three percent of the land is *unregulated*. This is commercial forest land that is not managed for timber production under sustained yield principles although timber harvest can be realized from these areas. Included are administrative sites and experimental forest land areas. *Marginal* lands account for 17 percent of the total commercial forest land area. These lands are a component of the regulated commercial forest land base not currently qualifying as standard or special components because of excessive development cost, low product values or resource protection constraints. Timber yields from marginal lands depend on reforestation funding, management and logging technology, and economic conditions.

TIMBER PRODUCTION RESTRICTIONS ON PRIVATE AND OTHER PUBLIC LANDS

Commercial forest land in private and other public ownership is not equally available for timber production. To estimate limitations to full timber production each field plot outside National Forests was classified into one of four caretories:

1. No apparent cultural or physical limitation to timber production. Much of this area is used for grazing but with little apparent effect on tree growth.

Private land	1,421,000 acres or 83 percent
Other public land	43,000 acres or 71 percent

2. Harsh sites, including arid transition zone forests, steep rocky slopes, high elevation sites with limited stockability, and areas with peridotite-serpentine soils.

Private land	180,000 acres or 10 percent
Other public land	18,000 acres or 29 percent

3. Recreational, residential, or commercial development immediately adjacent to the plot. This category does not include the thousands of acres of undeveloped subdivisions.

Private land	99,000 acres or 6 percent
Other public land	0

4. Grazing development through partial clearing sufficient to reduce timber production but with land still defined as commercial forest (most grazing developments take the land out of commercial forest) (fig. 9).

Private land	15,000 acres or 1 percent
Other public land	0

The three categories of land with timber yield limitations amount to 294,000 acres in private ownership and 18,000 acres in other public ownership, or 17 percent and 29 percent of the commercial forest land in each owner class, respectively.

Figure 9.--Residential developments restricts the use of commercial forest land.

Residential development may eventually limit timber production on many acres of forest land but there was no way to quantify this category. Examples of such areas are numerous. To mention a few: Most of Napa County; the Independence Lake area where a large resort type development has been proposed; Graeagle-Portola area, which is developing as a summer home center; Paradise-Magalia area which is rapidly becoming a city in the trees; much of the privately owned commercial forest between State Highway 49 (the Mother Lode route) and the National Forest boundary from Placerville to Nevada City; Martis Valley near Truckee; and underdeveloped land near Lake Tahoe.

CHANGES IN OWNERSHIP AND AREA OF COMMERCIAL FOREST LAND

Changes in commercial forest area and ownership in the Sacramento resource area were identified for the period between 1952 and 1972.[2] This was done using records of road, powerline, and water development construction, land transactions, forest conversions, and park dedications along with aerial photographs and forest inventory records. The changes we found are shown in the following tabulation:

Gains and Losses in Commercial Forest Land

Source of Change	Public lands	Private lands	Net balance total
	- - - - - - - -	Acres	- - - - - - - -
Ownership shifting	+13,000	-13,000	0
Roads, powerlines, and other conversions	-16,000	-19,000	-35,000
Parks, wilderness	+16,000	-10,000	+6,000
Harsh site reclassification[3]	-200,000	-130,000	-330,000
Unexplained differences[4]	-78,000	-18,000	-96,000
Net change	-265,000	-190,000	-455,000

Ownership changes have occurred continuously since 1953. National Forests acquired 13,000 acres of commercial forest land from private owners and 9,000 acres from other public owners, mostly the State of California and the Bureau of Land Management. Forest industry lands have increased by more than 100,000 acres, while other private lands have decreased by a similar amount. A few large timber companies have acquired lands from smaller companies. On other private ownerships, especially the miscellaneous private lands held by individuals and small corporations, land has been steadily subdivided for residential and recreational development.

---

[2] Statistics for 1953 are published. Forest Statistics for California. December 1954. Forest Survey Release 25. 66 p. California For. and Range Exp. Stn., Berkeley, Calif.

[3] Records of harsh site reclassification varied for the various National Forests and probably include other sources of difference.

[4] Unexplained differences are mainly due to judgment, procedures, and sampling error, and also include unclassified land in the Tahoe Basin Management Unit.

Physical conversion of commercial forest land to permanent roads, reservoirs, powerlines, pasture, and urban development accounted for 19,000 acres of private land. About 60 percent of this occurred in Nevada, Placer, and El Dorado Counties where residential development of forested areas is rapidly changing land use. Physical conversion in National Forests was mainly for roads. Powerlines and water development including dams, reservoirs, and waterways made up the bulk of the other physical conversions.

About 10,000 acres of private commercial forest land was donated to or purchased by the State and counties for parks. Included are lands purchased by the Nature Conservancy and held for eventual disposition as parks or other reservations. The commercial forest land base on National Forests has increased by about 16,000 acres from reclassification of reserved areas. This resulted from an increase in the boundaries of the Desolation Valley Wilderness which took 2,000 acres out of commercial forest use while reclassification of the Lakes Basin Recreational Area and a piece of the Yolla-Bolly--Middle Eel area placed about 18,000 acres back in commercial forest status. These areas had been carried as "reserved" by administrative decision but were not set aside by law until after the Wilderness Act (PL 88-577) of 1964. Boundaries were changed and some areas were dropped from the reserved category between 1953 and 1964.

About 130,000 acres of private forest lands were reclassified from commercial to noncommercial based on an improved method of estimating productivity (MacLean and Bolsinger 1973) in areas where tree stocking is limited due to aridity, rockiness, and other environmental factors.

At least 200,000 acres on National Forests were reclassified from commercial forest to noncommercial forest by Region 5 of the U.S. Forest Service. Included in this estimate are nonstocked burns where repeated reforestation failures revealed sites not feasible to manage, arid transition zones on the lower eastern and western slopes of the Sierra Nevada Range and the east slope of the Coast Range, unproductive sites in the granitic crest zone of the Sierra, and excessively steep slopes in river canyons.

There are 96,000 acres of change not directly accounted for but most likely attributable to procedural differences, judgment, and sampling error. On private land this is 18,000 acres and on public lands 78,000 acres. Part of the difference occurs on the National Forests as a result of classification of land within the Tahoe Basin Management Unit. This classification is awaiting a final decision.

WHITE FIR (MOST COMMON TYPE)

Forest types are determined on the basis of plurality of all live trees that contribute to stocking, considering both size and spacing. White fir is the most extensive type in the resource area covering 1 million acres and occurring with other species such as ponderosa pine and Douglas-fir at the lower elevation and forming pure stands in higher elevations or being mixed with red fir. Sixty-two percent of this type is found on National Forests. White fir has increased in area as ponderosa pine and Douglas-fir have been selectively removed.

The ponderosa pine type occupies 524 thousand acres on the west slopes of the Sierra Nevada and the east slopes of the Coast Range. The most important area of ponderosa pine lies in a belt of high site land along the lower west slope of the Sierra Nevada. Fifty-eight percent of the ponderosa pine area is in National Forests. Ponderosa pine mixes with oaks at low elevation and is an important component of the California mixed conifer association.

Douglas-fir type amounts to 513,000 acres of commercial forest land and is found in the mixed conifer type in the Sierra Nevada and the Coast Range. Fifty-eight percent of the Douglas-fir type is on National Forests.

Other coniferous types which are important include incense-cedar, red fir, and sugar pine. California black oak is the most extensive hardwood type covering 259,000 acres (fig. 10).

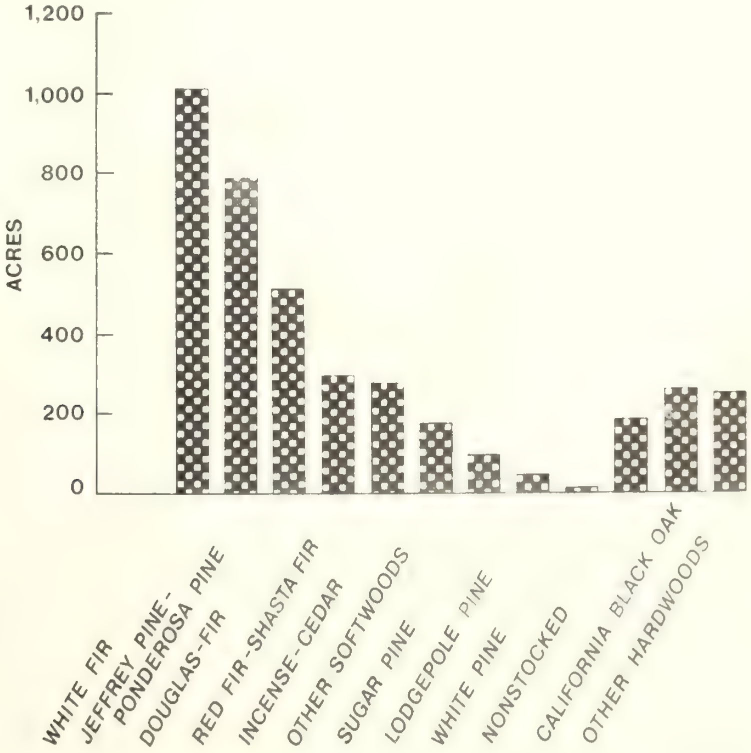


Figure 10.--Acreage by forest type.

SAWTIMBER STANDS DOMINATE RESOURCE AREA

Even though there has been a long history of timber harvest in the Sacramento resource area most of the remaining stands still contain enough sawtimber trees to be classed as sawtimber stands. This was caused by commonly used selective method of cutting which leaves a residual volume of sawtimber trees on many of the acres. Sawtimber stands occur on 3.1 million acres or 81 percent of the total commercial land area. Sixty four percent of the remaining sawtimber stands are classed as large sawtimber (larger than 21 inches in diameter).

Of the large sawtimber stands, 70 percent are found on National Forest lands. Only 4 percent of the commercial forest is in poletimber stands, and 11 percent is in sapling and seedling stands.

STOCKING HIGH ON PRIVATE LANDS

Private forest lands are generally well stocked with conifers. About three-fifths of the total commercial area in private ownership is at least 60 percent stocked with conifers. This level of stocking is generally considered adequate for realizing the growth potential of the land. On the other end of the scale, about one-fourth of the area is either poorly stocked or nonstocked. Many of the poorly stocked or nonstocked acres contain hardwoods that compete with the conifers for space and present management problems. Hardwoods and cull softwoods occupy more than 60 percent of the growing space on about half of the areas that are less than well stocked with conifer growing stock. Thus competition from these less desirable stand elements makes conversion to better conifer stocking difficult.

Stocking comparisons of private with public lands is not valid because the National Forest stocking figures have both conifers and hardwoods contributing toward stocking and can't be separated into components. National Forests have 41 percent of this area well stocked, 36 percent is moderately stocked, and 23 percent is nonstocked or poorly stocked.

TIMBER VOLUME

The volume of growing stock in the Sacramento resource area is 13 billion cubic feet, 23 percent of the total in the State of California. The volume of sawtimber amounts to 65 billion board feet (Scribner).5/ Softwoods account for 96 percent of the growing stock volume.

The volume estimates shown in the report account for practically all of the wood on commercial forest land. The

---

5/ Sawtimber volumes used in this text are in Scribner.

reported volume of growing stock is the net volume of all sound live trees of commercial species 5.0 inches in diameter or larger. Additional volume of commercial species not qualifying as growing stock include rotten cull, sound cull, and salvable dead trees; and their net volume is reported in these tree classes. The volume of noncommercial species occurring on commercial forest land is reported as sound cull. Of the total volume, about 3 percent is in cull and salvable dead trees.

National Forests have the bulk of the sawtimber volume and also the highest volume per acre as shown in the following tabulation:

Owner	Percent of sawtimber volume	Volume per acre bd. ft.
National Forests	64	19,749
Other public	1	8,869
Forest industry	18	17,685
Farm and misc. private	17	10,456

The softwood sawtimber volume in the resource area amounts to 65 billion board feet with 77 percent of the volume in trees greater than 21 inches in diameter. The hardwood sawtimber volume is only 1.1 billion board feet, and nearly half of this volume is in trees less than 20 inches in diameter.

White fir is the leading sawtimber species. The inventory amounts to 18 billion board feet, and most of this volume is on National Forests. Ponderosa pine and Jeffrey pine have a combined volume of 14.6 billion board feet, and Douglas-fir has a volume of 11 billion board feet. Other important species in terms of volume are red fir and sugar pine (fig. 11).

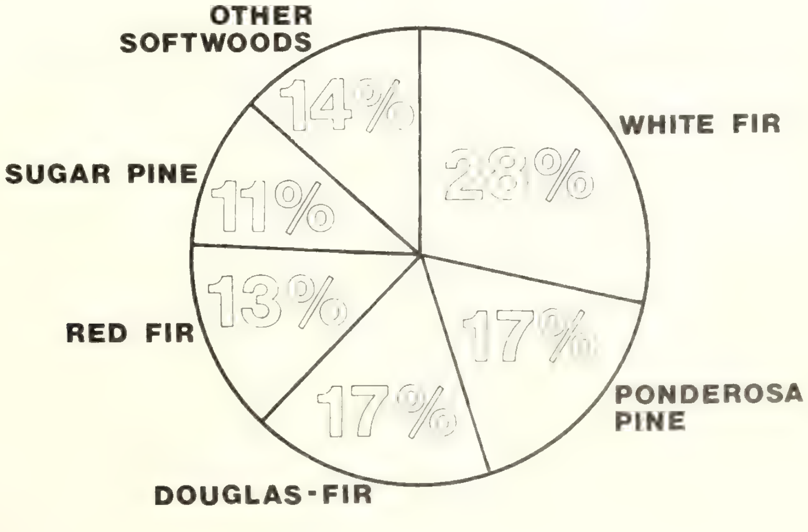


Figure 11.--Percent of softwood sawtimber volume by species.

TIMBER VOLUME CHANGE

The volume of sawtimber has been declining since 1953. Volume in public ownership (essentially National Forest) declined about 4 percent, and volume in private ownership declined 15 percent.[6] The present cut-growth balance shows that the public inventory is probably continuing to decline, but the inventory in private ownership is now increasing. The difference between the change that occurred between 1953 and 1972 and the current situation on private lands is due to the changing timber-cut over time, the increase in growth rates due to the large number of trees and stands that are entering the age of maximum growth, and the volume losses due to catastrophic forest fires in the early 1960's.

TIMBER GROWTH, CUT, AND MORTALITY

Net annual growth of sawtimber on all ownerships is 1.04 billion board feet or 2 percent of the inventory volume. Growing stock growth is 205 million cubic feet.

Forest industry lands have the highest gross growth per acre, and net growth per acre. National Forests and farm and miscellaneous private lands have the lowest mortality per acre as shown below:

	Gross growth per acre	Net growth per acre	Mortality per acre
		Cubic feet	
National Forest	57	50	7
Other public	62	49	13
Forest industry	75	63	12
Farm and misc. private	59	51	8
Average all owners	61	53	8

About 94 percent of the growing stock growth is from softwood species. White fir and red fir combined account for about 38 percent of the softwood growing stock growth.

---

[6] Statistics for 1953 are unpublished, on file at the Pacific Northwest Forest and Range Experiment Station.

Ponderosa pine and Jeffrey pine account for 25 percent of the growth as shown in figure 12.

Average annual mortality of growing stock trees, 5.0 inches in diameter and larger, for the 5-year period preceding the inventory was 33 million cubic feet. Softwoods account for 98 percent of the mortality. Half of the softwood mortality occurs in white and red fir (fig. 13).

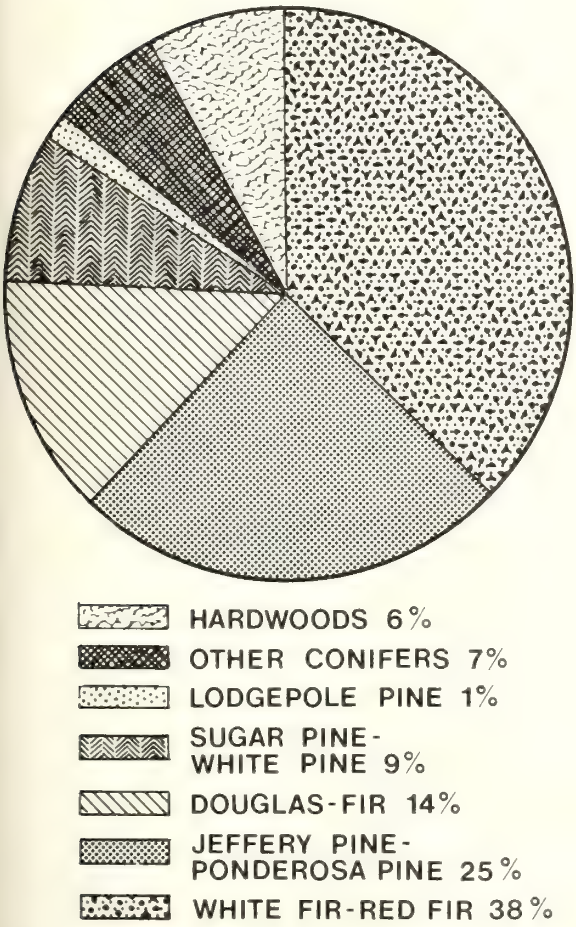


Figure 12.--Percent of net annual cubic foot growth by species, Sacramento resource area, 1972.

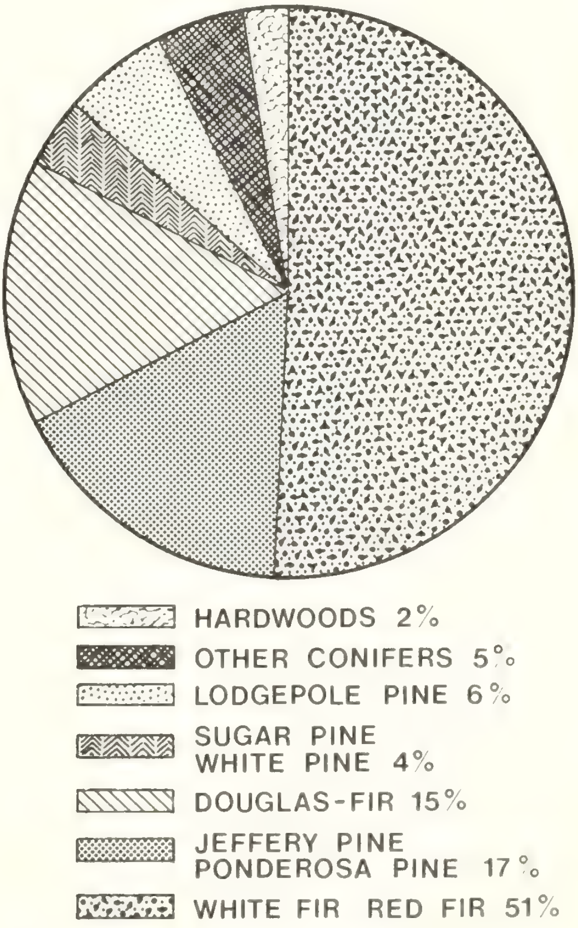


Figure 13.--Percent of annual mortality by species, Sacramento area, 1972.

The leading identifiable cause of mortality on lands outside of National Forests was weather (26 percent) followed by insects (14 percent), fire (8 percent), disease (4 percent), suppression (3 percent), and logging (2 percent). Forty-three percent of the mortality was unclassified. Some was due to the combined effect of several of the above agents but the primary cause of death could not be established. Other unclassified causes include landslides, exposure due to stand disturbance, damage by vehicles, and unrecognized suppression.

Hardwoods have the highest growth rates relative to inventory volume followed by ponderosa pine and Jeffrey pine and lodgepole pine has the highest mortality rate as shown below:

Species	Net annual cubic-foot growth as a percent of total species volume
Douglas-fir	1.3
White fir and red fir	1.5
Ponderosa and Jeffrey pine	1.8
Sugar and white pine	1.4
Lodgepole pine	1.0
Incense-cedar	1.6
Hardwoods	2.3
All species	1.6

In 1973, the Sacramento resource area had a timber harvest of 1.1 billion board feet (Scribner log rule) or 22 percent of the total cut in California. This harvest level has not changed appreciably since the late 1940's although there have been changes in production from individual counties.

Although the timber harvest of 1.1 billion board feet is about equal to the net growth of 1.0 billion board feet, the balance between cut and growth varies among owner groups. Harvest and growth values are equal only for forest industry.

	National Forests	Forest industry	Farm and miscellaneous private
	- - - - - (Board feet per acre - Scribner) - - - - -		
Net growth	280	350	270
Timber harvest	350	350	200

On forest industry lands it appears that the present harvest level can be maintained. Supporting this is the fact that the stands are unevenaged and the selective method of harvesting timber currently used tends to maintain the existing forest and forest conditions. On National Forest lands the timber harvest exceeds net growth and is a result of the conversion of a largely old-growth high volume-per-acre forest to a regulated young-growth forest. On farm and miscellaneous private lands, annual net growth exceeds the annual timber harvest by one-third. This is most likely due to several factors including ownership objectives which in some cases may include holding land for recreation or speculation. Also, these lands have only 60 percent of the per acre volume of industrially owned lands and may not now offer attractive timber harvesting opportunities. Obviously with 1,062,000 acres in this ownership compared to 653,000 acres in industrial ownership, future opportunities in the farm and miscellaneous private ownership could be considerable.

Whereas the inventory is predominantly white fir, the timber cut is mainly ponderosa pine. The following tabulation shows the estimated 1972 percentage of the harvest and inventory volume by species:

		Inventory volume percent
	Cut percent	Board foot Scribner
Ponderosa, Jeffrey, and sugar pine	43	33
True fir	34	41
Douglas-fir	12	17
Incense-cedar	5	5
Other softwood	5	2
Hardwoods	1	2
Total	100	100

Heavy cutting of ponderosa pine and sugar pine has altered the species mix to true firs. The change has been viewed by some as a problem. Industry people maintain that species characteristics will matter less in the future because all of the principal softwoods can be utilized.

The National Forests account for 55 percent of the timber harvest in this resource area, and the remaining cut comes mostly from the private lands although a small amount comes from other public lands. Twenty-one percent comes from forest industry lands and 19 percent comes from farmer and miscellaneous private lands.

FOREST INDUSTRY

In 1972 the forest industries in the Sacramento resource area consumed 1.2 billion board feet of timber. Ninety-three percent of this wood came from within the area, and the remainder came from nine other California counties and out of State (Howard 1974).

Of the wood consumed in the unit, 97 percent went to sawmills; and 69 percent of the wood consumed by sawmills came from trees more than 100 years old. In 1972 there were 39 sawmills with an installed, 8-hour capacity of 3.4 million board feet lumber tally. These mills produced one-fourth of California's lumber production. Sawmills consumed 1.16 billion board feet (Scribner) of logs in 1972.

There were two veneer plants located in El Dorado and Nevada Counties and a veneer and layup plant located in Tehama County. The veneer capacity amounted to 100,000 square feet (3/8-inch), and the veneer and layup plant's capacity amounted to 130,000 square feet. Eighty-five percent of the wood consumed in these plants was old growth. About 65 percent came from National Forests, one-fourth from industry lands, and one-tenth from farm and miscellaneous private lands. True firs were the main species used by these veneer and plywood plants.

There was one groundwood pulpmill in Tehama County and a particle board plant in Plumas County. The pulpmill capacity amounted to 80 tons per day, and the particle board capacity was 120,000 square feet (3/4-inch basis). These mills used only mill residues.

The single wood preserving plant consumed roundwood from Butte County. The capacity for post, pole, and pilings amounted to 7.3 million board feet per year. Post, pole, and piling operations used young-growth timber and depended heavily on nonindustrial private lands. Logs were exported by one firm in Sacramento.

In 1972, sawmills produced 1.25 million tons of wood residue in the Sacramento unit. Seventy-nine percent of this volume was used as raw material for other products. Pulp plants consumed 438,323 tons, and 444,581 tons was burned as fuel. Board and other plants used 105,346 tons of wood residue.

FOREST-BASED EMPLOYMENT

Average employment was about 9,000 in the forest industries of the Sacramento unit. Lumber and wood products manufacturing employed about 8,000 workers. Logging accounted for 13 percent, sawmills and planing mills 50 percent, and millwork 14 percent. There were 700 employees working in the manufacture of prefabricated wooden buildings and structural members and 600 employees in the manufacture of nailed and locked corner wooden boxes and shook.

Employment in pulp, paper, and allied products amounted to 1,200 workers. This industry includes manufacture of bags, pressed and molded pulp goods, folding paper boxes, and corrugated and solid fiber boxes.

INVENTORY PROCEDURES

The statistics for National Forests lands that are included in this report were collected by National Forest personnel from the Eldorado, Lassen, Mendocino, Plumas, Tahoe, Trinity, and the Toiyabe National Forests. Data for all other lands were collected by Forest Resources Evaluation personnel of the Pacific Northwest Forest and Range Experiment Station.

The same standards were used for all data elements, but slightly different collection procedures were used for some areas and certain data items: National Forests, except the Eldorado, and all lands outside National Forests, were inventoried using a double sampling design. First, aerial photo sample plots 1 acre in size were distributed systematically across the area and classified into commercial forest, noncommercial forest, and nonforest. Commercial forest plots were further classified into several stand volume classes. In addition, plots outside National Forests were classified by kind of owner, using county tax assessor records. A random sample of field plots was selected proportional to the number of aerial photo plots in each forest and in each land, volume, and ownership class on lands outside National Forests. The field sample was used to adjust the aerial photo sample for photo interpretation errors and changes since date of photography and also provided detailed stand data such as stocking by species, volume by size class, etc. Field plots consisted of 10 sample points distributed over an acre. The variable radius plot sampling principle was used to select tally trees of 5.0 inches and larger. Trees smaller than 5-inch d.b.h. were tallied on a circular fixed radius plot. Where no trees were tallied, a ground cover class was recorded.

For the Eldorado National Forest a type map was made on which commercial, noncommercial, and nonforest land classes were delineated. Commercial forest areas were then further divided into condition classes and major types. Type-mapped areas of noncommercial and nonforest land were accepted without ground checking. The commercial forest area was sampled with field plots distributed proportional to area by condition class and major type. Field plots consisted of five sample points 132 feet apart in an L-shape. At each point, the variable radius plot sampling principle was used to select tally trees 1-inch d.b.h. and larger. Trees smaller than 1-inch d.b.h. were tallied on a circular fixed radius plot.

Growth and mortality estimates for National Forests except the Eldorado and Toiyabe were developed from data taken from plots measured at two or more points in time over a 7- to 20-year period. This information was supplemented with measurements of past 10-year's growth on increment borings and postdated mortality over the past 5 years.

Growth and mortality estimates for the Eldorado and Toiyabe National Forests and lands outside National Forests were developed from 10-year increment borings and 5-year postdating of dead trees.

For all National Forests except the Eldorado the sample consisted of approximately 5,820 aerial photo plots within the Sacramento resource area, and 1,125 field plots including 790 on commercial forest land, 255 on noncommercial forest land, and 82 on nonforest land. The Eldorado National Forest's field sample consisted of about 80 plots within the resource area.

For lands outside the National Forest the sample consisted of 16,428 aerial photo plots and 1,310 field plots, including 361 on commercial forest land, 431 on noncommercial forest land, and 518 on nonforest land.

Fieldwork on commercial forest land was completed as follows:

Outside National Forests	1971
Region 5 National Forests	
Eldorado	1974
Lassen	1970
Mendocino	1971
Plumas	1969
Tahoe	1972
Trinity	1969
Toiyabe National Forest (Region 4)	1975

No attempt was made to adjust the information from the various dates of collection to a common date. The annual change in volume indicated by growth and cut amounts to about -0.2 percent for National Forests and +0.1 percent for other ownerships. Adjusting all inventories to a common date would produce very insignificant differences in the volume estimates from those presented in this report.

The information on both productive and unproductive forests in reserved areas including National, State, and county parks, and National Forest wilderness and natural areas was obtained by aerial photo sampling and type-mapping procedures and by collecting existing data from agency records.

RELIABILITY OF FOREST RESOURCE ESTIMATES

Forest Land Area and Timber Volume

The estimates of forest land area and timber volume in the Sacramento area were derived by sampling and thus have sampling error. Sampling errors have been computed for the estimate of commercial forest land area, noncommercial forest land area, net cubic-foot volume of growing stock, and net board-foot volume (International 1/4-inch rule) of sawtimber. These sampling errors are presented in table 1 as a percent of the estimated total at the 68- and 95-percent probability levels. They may be interpreted as meaning that the odds are two out of three for 68-percent probability, or 19 out of 20 for 95-percent probability that the ranges shown includes the true value (i.e., the results of a 100-percent inventory). For example, we can expect, with 95-percent confidence, that the estimate of commercial forest land area--3,611,000 acres ± 3.00 percent (108,330 acres)--includes the true values.

In addition to measurable sampling errors, there may be nonsampling errors due to mistakes in judgment, measurement, and compilation. The magnitude of errors of this nature cannot be determined. Such errors, however, are kept to a minimum through training, supervision, field checking, and complete editing and machine verification in compiling the data.

The sampling error of any breakdown of these totals will be substantially greater than the total. The smaller the breakdown, the larger the sampling error. An approximation of increasing sampling error can be obtained from table 2, which shows the sampling error associated with smaller estimates.

DEFINITION OF TERMS

LAND AREA

Total land area is that area reported by the Bureau of the Census and includes dry land and land temporarily or partially covered by water (such as marshes, swamps, and river flood plains), streams, sloughs, and canals less than 1/8-mile wide and lakes, reservoirs, and ponds less than 40 acres in area.

Forest land is at least 10 percent stocked by trees of any size, or formerly having such tree cover, and not currently developed for nonforest use. Minimum area of land recognized as forest is 1 acre.

Nonforest land has never supported forests or was formerly forested and is currently developed for nonforest uses. Included are areas used for agricultural crops, improved pasture, residential areas, city parks, improved roads of any width and their right-of-way clearings, powerline clearings of any width, and 1- to 40-acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and other nonforest strips must be more than 120 feet wide and clearings etc. more than 1 acre in size to qualify as nonforest land.

FOREST LAND CLASSES

Commercial forest land is capable of producing 20 cubic feet per acre per year of industrial wood and not withdrawn from timber utilization.

Noncommercial forest land consists of unproductive forest land and productive reserved forest land.

Productive reserved forest land is withdrawn from timber utilization through statute, ordinance, or administrative order but otherwise qualifies as commercial forest land.

Unproductive forest land is incapable of yielding crops of industrial wood products because of adverse site conditions such as sterile soil, poor drainage, high elevation, steepness, and rockiness.

FOREST TYPES

Forest types are determined on the basis of species plurality of all live trees that contribute to stocking, considering both size and spacing.

TREE CLASSES

Sawtimber trees, poletimber trees, saplings, and seedlings are included as *growing stock.*

Sawtimber trees are growing-stock trees and are at least 9.0 inches in d.b.h. if they are softwoods, and at least 11.0 inches d.b.h. if they are hardwoods. At least 25 percent of the board-foot volume in any sawtimber tree must be free from defect. Softwood trees must contain at least one 12-foot sawlog with a top diameter of not less than 6 inches inside the bark; hardwood trees must contain at least one 8-foot sawlog with a top diameter of not less than 8 inches inside the bark.

Poletimber trees are 5.0- to 8.9-inch d.b.h., live, and of commercial species, not less than 25 percent sound on a cubic-foot basis, and with no disease, defects, or deformities which are likely to prevent them from becoming growing-stock sawtimber trees.

Sapling and seedling trees are less than 5.0-inch d.b.h., live, of commercial species, and have no disease, defects, or deformities which are likely to prevent them from becoming growing-stock poletimber trees.

Nongrowing Stock

Cull trees are noncommercial species or commercial species which are too defective or which are unlikely to become growing-stock trees due to deformity, disease, low vigor, etc.

Sound cull trees are noncommercial species or commercial species with excessive defect due to form, roughness, etc.

Rotten cull trees have excessive defect due primarily to rot.

Mortality trees are commercial species which have died from natural causes within a specified period and which were not cull trees at the time of death.

Salvable dead trees are standing or down, of commercial species, 11.0 inches or more in diameter, containing 25 percent or more of sound volume and at least one merchantable 16-foot log if a softwood or one merchantable 8-foot log if a hardwood.

STAND SIZE CLASSES

Sawtimber stands are at least 10.0 percent stocked with growing-stock trees, with half or more of this stocking in sawtimber and poletimber trees and with sawtimber stocking equal to or greater than poletimber stocking. In *large sawtimber stands*, the majority of the sawtimber stocking is in trees 21.0 inches and larger at breast height. In *small sawtimber stands*, the majority of the sawtimber stocking is in softwood trees from 9.0 to 20.9 inches d.b.h. and hardwood trees 11.0 to 20.9 inches d.b.h.

Poletimber stands are at least 10.0 percent stocked with growing-stock trees, with half or more of this stocking in sawtimber and poletimber trees, and with poletimber stocking exceeding sawtimber stocking.

Sapling and seedling stands are at least 10.0 percent stocked with growing-stock trees, with more than half of this stocking in saplings, seedlings, or both.

Nonstocked areas of commercial forest land are less than 10.0 percent stocked with growing-stock trees.

STOCKING

Stocking is a measure of how well the productive potential of the site is being utilized by trees. For stands with a mean d.b.h. of at least 8 inches, the measure of stocking used is relative density expressed as a percent of normal stocking, i.e., the current number of trees per acre expressed as a percent of the normal number indicated for a stand of the same mean diameter and species. For stands with a mean diameter of less than 8 inches, stocking does not indicate the current level of site utilization but rather estimates the degree of site utilization that is expected when the stand reaches 8 inches in mean diameter. For such stands, the stocking standard is the normal number of trees for an 8-inch stand, discounted for expected mortality. In stands of mixed size and species, the density standard used is a weighted average for the various species and sizes of trees present.

In general, stocking standards are based on normal yield tables such as USDA Technical Bulletin No. 630 (Meyer 1961). Some sites, however, because of hot dry conditions, serpentine soils, rock outcrops, or other restrictions, are unable to support the density of trees indicated by the normal yield tables. On such areas, stocking standards are adjusted to reflect lower stocking capacity (MacLean and Bolsinger 1973, 1974).

Full normal stocking (100 percent in this report) requires far more trees than are needed to fully occupy the site. In general, stands in excess of 60-percent stocking are considered to be fully occupying their sites.

TIMBER VOLUME

Net volume of *live sawtimber* trees of commercial species is measured in board feet. Net volume equals gross volume less deduction of rot, sweep, crook, and other defects that affect use for lumber.

Scribner rule is the common board-foot log rule used locally in determining volume of sawtimber. Scribner volume was computed on a 16-foot log basis to a California utilized top[7] for trees 11.0-inch d.b.h. and larger.

International 1/4-inch rule is the standard board-foot log rule adopted nationally by the Forest Service for the presentation of Forest Survey volume statistics. For calculating International 1/4-inch board-foot volume the minimum diameter for softwood trees is 9.0-inch d.b.h. and the minimum log length is 12 feet with a small end diameter of 7.0 inches outside bark. The minimum diameter for hardwoods is 11.0-inch d.b.h., with a minimum log length of 8 feet and a small diameter of 9.0 inches outside bark.

---

[7] Utilization study data are on file at the Pacific Southwest Forest and Range Experiment Station, Berkeley, California.

Growing stock is calculated from the net volume in cubic feet of live sawtimber trees and live poletimber trees from stump to a minimum 4.0-inch top (of central stem) outside bark is measured. Net volume equals gross volume less deduction for rot and missing bole sections.

Industrial wood includes all roundwood products except fuelwood.

Net annual growth is the net increase in volume of trees during a specified year. (Components of net annual growth include: (a) the increment in net volume of trees at the beginning of the specified year surviving to the year's end plus (b) the net volume of trees reaching the size class during the year, minus (c) the net volume of trees that died during the year, minus (d) the net volume of trees that become culls during the year.)

OWNERSHIP CLASSES

National Forest lands are Federal lands which have been designated by Executive Order or statute as National Forests or purchase units and other lands under the administration of the Forest Service, including experimental areas and Bankhead-Jones title III lands.

Other public lands are Federal lands other than National Forests, including lands administered by the Bureau of Land Management, Bureau of Indian Affairs, and miscellaneous Federal agencies, and lands owned by States, counties, and local public agencies or lands leased by these governmental units for more than 50 years.

Forest industry lands are owned by companies or individuals operating wood-using plants.

Farmer-owned lands are lands owned by operators of farms.

Miscellaneous private-corporate lands are owned by companies or corporations that do not operate wood-using plants. Included are corporate farms, some railroad lands, oil company lands, real estate and land-holding company lands, and lands held by banks and other financial institutions and various other companies and corporations.

Miscellaneous private-noncorporate lands are privately owned lands other than forest industry, farmer-owned, or corporate lands.

APPENDIX I

The principal tree species found in the Sacramento resource area:

Scientific name	Common name
Abies concolor (Gord. & Glend.) Lindl.	white fir
Abies magnifica A. Murr.	California red fir
Abies magnifica var. *shastensis* Lemm.	Shasta red fir
Acer macrophyllum Pursh	bigleaf maple
Aesculus californica (Spach) Nutt.	California buckeye
Arbutus menziesii Pursh	Pacific madrone
Cercocarpus H.B.K. Spp.	mountain-mahogany
Fraxinus latifolia Benth.	Oregon ash
Juniperus occidentalis Hook.	western juniper
Libocedrus decurrens Torr.	incense-cedar
Lithocarpus densiflorus (Hook. & Arn.) Rehd.	tanoak (tree)
Pinus attenuata Lemm.	knobcone pine
Pinus contorta Dougl.	lodgepole pine
Pinus jeffreyi Grev. & Balf.	Jeffrey pine
Pinus lambertiana Dougl.	sugar pine
Pinus monticola Dougl.	western white pine
Pinus ponderosa Laws.	ponderosa pine
Pinus sabiniana Dougl.	Digger pine
Platanus racemosa Nutt.	California sycamore
Populus fremontii S. Wats.	Fremont cottonwood
Populus trichocarpa Torr. & Gray	black cottonwood
Pseudotsuga menziesii (Mirb.) Franco	Douglas-fir
Quercus chrysolepsis Liebm.	canyon live oak
Quercus douglasii Hook. & Arn.	blue oak
Quercus garryana Dougl. var. *breweri* Jeps	Oregon white oak
Quercus kelloggii Newb.	California black oak
Quercus lobata Ne´e	California white oak
Quercus wislizenii A. DC.	interior live oak
Salix L. Spp.	willow
Tsuga mertensiana (Bong.) Carr.	mountain hemlock
Umbellularia californica (Hook. & Arn.) Nutt.	California-laurel

LITERATURE CITED

Howard, James O.
1974. California forest industry wood consumption and characteristics, 1972. USDA For. Serv. Resour. Bull. PNW-52, 91 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oregon.

MacLean, Colin D., and Charles L. Bolsinger.
1973. Estimating productivity on sites with a low stocking capacity. USDA For. Serv. Res. Pap. PNW-152, 18 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

MacLean, Colin D., and Charles L. Bolsinger.
1974. Stockability equations for California forest land. USDA For. Serv. Res. Note PNW-233, 10 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Meyer, Walter H.
1961. Yield of even-aged stands of ponderosa pine. USDA Tech. Bull. No. 630, 59 p. Washington, D.C.

APPENDIX II

Table 1--*Sampling errors of estimate of forest area and timber volume, Sacramento area, California, January 1, 1971*

Item	Estimated total	Sampling error in percent	
		68-percent probability	95-percent probability
Commercial forest land[1]	3,611,000 acres	±1.53	+3.00
Noncommercial forest land[2]	3,323,000 acres	±4.02	±7.88
Volume:			
Growing stock	13,042 million cubic feet	+2.23	±4.37
Sawtimber (International 1/4-inch rule)	74,472 million board feet	±1.56	±3.06

[1] In addition to the estimated 3,611,000 acres of commercial forest land derived by sampling methods, 284,000 acres of commercial forest land on the Eldorado National Forest were determined by type-mapping procedures and have no sampling error.

[2] In addition to the estimated 3,323,000 acres of noncommercial forest land derived by sampling methods, 89,000 acres of unreserved-unproductive on the Eldorado National Forest and 101,000 of forest land in parks and other reservations were determined by type-mapping procedures and have no sampling error.

Table 2--*Approximate sampling error by size of estimate, Sacramento area, California, January 1, 1971*

Commercial		Growing stock		Sawtimber	
Area	Sampling error	Volume	Sampling error	Volume	Sampling error
Thousand acres	*Percent*	*Million cu. ft.*	*Percent*	*Million bd. ft.*[1]	*Percent*
3,611	1.53	13,042	2.23	74,742	1.56
2,113	2.0	7,206	3.0	45,309	2.0
939	3.0	4,054	4.0	20,137	3.0
528	4.0	2,594	4.0	11,327	4.0
338	5.0	649	10.0	7,249	5.0
84	10.0	299	15.0	1,812	10.0
38	15.0	162	20.0	805	15.0
21	20.0	104	25.0	453	20.0
13	25.0	72	30.0	290	25.0
9	30.0			201	30.0

[1] International 1/4-inch rule.

Table 3--Area by land class and county, Sacramento area, California, January 1, 1972

(In thousand acres)

Land class	All counties	Butte	Colusa	El Dorado	Glenn	Lake	Napa	Nevada	Placer	Plumas	Sacramento	Sierra	Sutter	Tehama	Yolo	Yuba
Forest land:																
Commercial	3,895	341	19	538	119	138	36	308	365	1,084	--	382	3	460	2	100
Productive reserved	71	1	1/	9	--	1/	1	2	1/	17	1/	--	--	41	--	1/
Unproductive	3,442	199	216	272	206	502	295	189	231	286	14	91	17	729	113	82
Total	7,408	541	235	819	325	640	332	499	596	1,387	14	473	20	1,229	115	182
Nonforest land[2]	5,339	505	502	219	519	167	172	122	318	253	610	140	366	681	543	223
Unclassified[3]	66	--	--	66	--	--	--	--	--	--	--	--	--	--	--	--
Total area[4]	12,813	1,046	737	1,104	844	807	504	621	914	1,640	624	613	386	1,909	658	406

[1] Less than 500 acres.

[2] Includes cropland, pasture and range, swampland, industrial and urban areas, powerline clearings, railroads, and all improved roads and highways and 58,714 acres classified as water by Forest Survey standards but defined by the Bureau of the Census as land.

[3] Unclassified land in the El Dorado County portion of the Tahoe Basin Management Unit is primarily nonforest and noncommercial forest.

[4] Source. United States Bureau of the Census, Land and Water Area of the United States, 1970.

Table 4--Area of commercial forest land, by ownership class and county, Sacramento area, California, January 1, 1972

(In thousand acres)

Ownership class	All counties	Butte	Colusa	El Dorado	Glenn	Lake	Napa	Nevada	Placer	Plumas	Sacramento	Sierra	Sutter	Tehama	Yolo	Yuba
National Forest	2,120	93	16	256	89	80	--	105	167	776	--	282	--	215	--	39
Other public	61	10	--	11	--	--	--	13	15	4	--	3	--	4	--	2
Private:																
Forest industry	653	113	--	99	20	12	--	5	58	103	--	30	--	213	--	1
Farmer-owned	216	11	1	68	6	19	15	12	3	45	--	18	1	10	1	8
Miscellaneous private--corporate	406	55	1/	21	1/	5	1	96	42	117	--	28	1/	14	--	27
Miscellaneous private--noncorporate	440	59	2	82	5	23	20	78	81	39	--	21	1	4	1	24
Total private	1,715	238	3	271	31	58	36	190	184	304	--	97	3	240	2	58
All ownerships[2]	3,895	341	19	538	119	138	36	308	365	1,084	--	382	3	460	2	100

[1] Less than 500 acres.

[2] Numbers may not add to totals due to rounding.

Table 5--*Area of commercial forest land, by stand-size and ownership class, Sacramento area, California, January 1, 1972*

(In thousand acres)

Stand-size class	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Sawtimber stands:					
Large sawtimber[1]	1,999	1,400	25	284	290
Small sawtimber[2]	1,143	420	22	246	455
Total	3,141	1,820	47	529	745
Poletimber stands	165	99	2	24	40
Sapling and seedling stands	430	116	12	95	207
Nonstocked areas	158	84	--	4	70
Total[3]	3,895	2,120	61	653	1,062

[1] Large sawtimber includes trees 21.0-inch d.b.h. and larger.

[2] Small sawtimber includes softwood trees 9.0- t0 20.9-inch d.b.h. and hardwood trees 11.0- to 20.9-inch d.b.h.

[3] Numbers may not add to totals due to rounding.

Table 6--*Area of commercial forest land, by cubic-foot site and ownership classes, Sacramento area, California, January 1, 1972*

Site class[1]	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Cubic feet	Thousand acres				
225 or more	23	13	--	--	10
165 to 224	372	307	3	37	25
120 to 164	745	433	--	147	165
85 to 119	898	498	9	141	250
50 to 84	1,222	610	36	208	368
20 to 49	634	258	13	119	244
Total[2]	3,895	2,120	61	653	1,062

[1] A classification in terms of capacity for cubic-foot annual growth per acre at culmination of mean annual growth in fully stocked stands.

[2] Numbers may not add to totals due to rounding.

Table 7--*Area of commercial forest land by stocking class of all growing-stock trees and ownership class, Sacramento area, California, January 1, 1972*

(In thousand acres)

Stocking percent[1]	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
81+	576	302	1	115	158
61 to 80	1,224	563	33	290	338
36 to 60	1,304	760	13	198	333
11 to 35	632	410	14	45	163
0 to 10	158	84	--	4	70
Total[2]	3,895	2,120	81	653	1,062

[1] See "Definition of Terms."

[2] Numbers may not add to totals due to rounding.

Table 8--*Area of commercial forest land by stocking percent, stand component, and cubic-foot site class on other public lands, Sacramento area, California, January 1, 1972.*

Stocking percent in softwood growing-stock trees and site	Stocking percent in hardwood and cull softwood trees					
	0 - 10	11 - 35	36 - 60	61 - 80	81+	Total
	Thousand acres					
0 - 10						
High site	--	--	--	--	--	--
Medium site	--	--	--	3	--	3
Low site	--	--	--	--	--	--
11 - 35						
High site	--	--	--	--	--	--
Medium site	--	--	--	--	--	--
Low site	--	--	--	--	5	5
36 - 60						
High site	--	--	--	--	--	--
Medium site	--	--	2	--	--	2
Low site	10	--	7	3	2	23
61 - 80						
High site	--	--	--	--	--	--
Medium site	--	--	--	--	--	--
Low site	--	--	2	--	3	6
81+						
High site	1	1	--	--	--	3
Medium site	5	--	--	--	--	5
Low site	5	5	7	--	--	16
Totals						
High site	1	1	--	--	--	3
Medium site	5	--	2	3	--	9
Low site	15	5	16	3	10	49
Total[1]	21	6	18	6	10	61

---

[1] Numbers may not add to totals due to rounding.

Table 9--*Area of commercial forest land by stocking percent, stand component, and cubic-foot site class on private lands, Sacramento area, California, January 1, 1972.*

Stocking percent in softwood growing-stock trees and site	Stocking percent in hardwood and cull softwood trees					
	0 - 10	11 - 35	36 - 60	61 - 80	81+	Total
	Thousand acres					
0 - 10						
High site	--	--	--	--	--	--
Medium site	4	15	3	10	48	80
Low site	13	4	23	14	39	93
11 - 35						
High site	--	--	--	--	11	11
Medium site	29	--	19	13	36	97
Low site	52	15	21	5	16	110
36 - 60						
High site	--	--	--	19	--	19
Medium site	14	--	24	27	25	90
Low site	38	38	24	9	28	137
61 - 80						
High site	--	--	--	--	4	4
Medium site	45	19	9	15	9	97
Low site	75	29	64	--	--	167
81+						
High site	25	--	13	--	--	38
Medium site	218	103	18	--	--	339
Low site	275	120	37	--	--	432
Totals						
High site	25	--	13	19	15	72
Medium site	310	136	73	66	118	704
Low site	453	207	169	28	82	939
Total[1]	788	343	255	113	216	1,715

---

[1] Numbers may not add to totals due to rounding.

Table 10--*Area of commercial forest land, by forest type and ownership class, Sacramento area, California, January 1, 1972*

(In thousand acres)

Forest type	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Douglas-fir	513	296	5	109	103
White fir	1,011	631	6	168	206
Red fir	296	194	5	49	48
Ponderosa pine	524	305	11	105	103
Jeffrey pine	267	180	5	31	51
Sugar pine	92	60	1	27	4
Western white pine	15	5	--	--	10
Lodgepole pine	46	18	--	5	23
Knobcone pine	3	3	--	--	--
Mountain hemlock	[1]	[1]	--	--	--
Incense-cedar	276	79	8	68	121
Unclassified softwoods[2]	155	155	--	--	--
Other softwoods	21	21	--	--	--
Aspen	7	7	--	--	--
Cottonwood	3	--	3	--	--
California black oak	259	42	6	50	161
Madrone	30	--	--	--	30
Other hardwoods	214	34	11	37	132
Noncommercial conifers	5	5	--	--	--
Noncommercial hardwoods	5	--	--	--	5
Nonstocked	158	84	--	4	70
Total[3]	3,895	2,120	61	653	1,062

[1] Less than 500 acres.

[2] Classified as mixed conifer on the Eldorado National Forest.

[3] Numbers may not add to totals due to rounding.

Table 11--*Area of reserved noncommercial forest land by ownership class and forest type or land class, Sacramento area, California, January 1, 1972*

(In thousand acres)

Forest type or land class	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Productive:					
Douglas-fir	7	5	2	--	--
Red fir	5	4	1	--	--
True fir	21	4	17	--	--
Ponderosa pine	29	27	2	--	--
Jeffrey pine	1	--	1	--	--
Sugar pine	2	1	1	--	--
Western white pine	1	1	[1]	--	--
Lodgepole pine	1	--	1	--	--
Mountain hemlock	2	[1]	2	--	--
Redwood	[1]	--	[1]	--	--
Incense-cedar	[1]	--	[1]	--	--
Cottonwood	[1]	--	[1]	--	--
Total[2]	71	42	29	--	--
Unproductive:					
Rocky	18	17	1	--	--
Oak	4	--	4	--	--
Chaparral	7	5	2	--	--
Low site	2	2	--	--	--
Willow	[1]	--	[1]	--	--
Total[2]	32	24	8	--	--
Total reserved	103	66	37	--	--

[1] Less than 500 acres.

[2] Numbers may not add to totals due to rounding.

Table 12--*Area of unreserved unproductive noncommercial forest land by ownership class and forest type or land class, Sacramento Area, California, January 1, 1972*

(In thousand acres)

Forest type or land class	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Rocky:					
Douglas-fir	24	19	--	[1]	5
White fir	39	31	--	2	6
Shasta red fir	41	36	--	--	5
Ponderosa pine	45	45	--	[1]	--
Jeffrey pine	70	59	--	2	9
Sugar pine	12	12	--	--	--
Lodgepole pine	8	--	--	--	8
Mountain hemlock	2	2	--	--	--
California black oak	14	14	--	--	--
Oregon white oak	2	2	--	--	--
Other hardwoods	41	30	3	8	--
Noncommercial conifers	8	8	--	--	--
Noncommercial hardwoods	8	8	--	--	--
Total[2]	315	266	3	13	33
Low Site:					
Douglas-fir	2	2	--	--	--
White fir	22	22	--	--	--
Shasta red fir	25	25	--	--	--
Ponderosa pine	61	24	--	--	37
Jeffrey pine	46	22	--	--	24
Sugar pine	4	4	--	--	--
Western white pine	3	3	--	--	--
Lodgepole pine	18	--	--	--	18
Incense-cedar	5	--	--	5	--
Aspen	3	--	--	3	--
California black oak	40	3	--	--	37
Other hardwoods	17	13	--	--	4
Noncommercial conifers	74	16	18	--	40
Noncommercial hardwoods	15	15	--	--	--
Nonstocked	30	--	--	--	30
Total[2]	367	150	18	8	191
Critical Watershed:					
Douglas-fir	6	6	--	--	--
Adverse Location:					
Douglas-fir	19	19	--	--	--
White fir	13	13	--	--	--
Shasta red fir	2	2	--	--	--
Ponderosa pine	37	37	--	--	--
Jeffrey pine	3	3	--	--	--
California black oak	8	8	--	--	--
Noncommercial hardwoods	2	2	--	--	--
Total[2]	84	84	—	--	--
Juniper	11	11	--	--	--
Oak madrone	1,723	71	155	10	1,487
Chaparral	802	263	190	1	348
Willow	4	--	--	—	4
Other	--	--	--	--	[1]
Unclassified[3]	97	97	--	--	--
Total unreserved unproductive[2]	3,410	949	366	32	2,063

---

[1] Less than 500 acres.

[2] Numbers may not add to totals due to rounding.

[3] No breakdown is available for 88,000 acres of Eldorado National Forest. This includes 9,000 acres of other unclassified areas.

Table 13--Area of commercial forest land and volume of growing stock and sawtimber,[1] by stand age and ownership classes, Sacramento area, California, January 1, 1972

Stand-age class	All ownerships			National Forest			Other public			Forest industry			Farmer and miscellaneous private		
	Area	Growing stock	Sawtimber	Area	Growing stock	Sawtimber	Area	Growing stock	Sawtimber	Area	Growing stock	Sawtimber	Area	Growing stock	Sawtimber
Years	Thousand acres	Million cubic feet	Million board feet	Thousand acres	Million cubic feet	Million board feet	Thousand acres	Million cubic feet	Million board feet	Thousand acres	Million cubic feet	Million board feet	Thousand acres	Million cubic feet	Million board feet
Nonstocked	158	30	149	84	11	62	--	--	--	4	--	--	70	19	87
0- 9	220	88	461	49	19	106	8	5	20	63	39	227	100	25	108
10- 19	41	27	151	14	5	22	--	--	--	8	15	94	19	7	35
20- 29	40	18	64	14	6	16	--	--	--	8	5	23	18	7	25
30- 39	43	44	212	11	6	29	--	--	--	12	8	39	20	30	144
40- 49	67	109	478	39	53	240	--	--	--	9	20	106	19	36	132
50- 59	152	415	1,824	55	152	836	1	4	18	27	115	378	69	144	592
60- 69	142	492	2,573	79	253	1,330	3	4	22	22	117	570	38	118	651
70- 79	132	426	2,178	70	268	1,425	3	4	22	13	32	120	46	122	611
80- 89	72	408	2,479	45	212	1,308	--	--	--	8	62	355	19	134	816
90- 99	57	216	1,223	38	154	930	2	11	59	9	28	111	8	23	114
100-119	95	476	2,956	74	383	2,382	--	--	--	5	31	211	16	62	363
120-139	57	167	1,045	39	137	862	--	--	--	--	--	--	18	30	183
140-159	22	87	549	22	87	549	--	--	--	--	--	--	--	--	--
160-179	20	49	297	20	49	297	--	--	--	--	--	--	--	--	--
180-199	25	99	628	25	99	628	--	--	--	--	--	--	--	--	--
200 and over	155	967	6,135	140	905	5,741	--	--	--	15	62	394	--	--	--
Uneven-aged under rotation age	1,442	4,217	24,379	674	2,185	11,611	29	62	326	277	947	5,266	462	1,023	5,176
Uneven-aged over rotation age	951	4,706	28,563	628	3,097	18,645	14	31	177	170	876	5,548	139	702	4,193
Total[2]	3,896	13,042	74,348	2,120	8,082	47,028	61	122	644	653	2,358	13,443	1,062	2,480	13,233

---

[1] International 1/4-inch rule.

[2] Numbers may not add to totals due to rounding.

Table 14--*Area of commercial forest land, by stand volume and ownership classes, Sacramento area, California, January 1, 1972*

(In thousand acres)

Stand volumes per acre[1]	All ownerships	National Forest[2]	Other public	Forest industry	Farmer and miscellaneous private
Less than 1,500 board feet	354	146	--	25	183
1,500 to 4,999 board feet	466	156	18	75	217
5,000 to 9,999 board feet	631	276	26	118	211
10,000 to 19,999 board feet	905	433	9	188	275
20,000 to 29,999 board feet	479	321	5	88	65
30,000 to 39,999 board feet	327	221	2	70	34
40,000 to 49,999 board feet	223	123	1	62	37
50,000 to 59,999 board feet	87	64	--	5	18
60,000 to 69,999 board feet	55	45	--	5	5
70,000 to 79,999 board feet	46	24	--	5	17
80,000 to 89,999 board feet	20	15	--	5	--
90,000 board feet or more	19	11	--	8	--
Total[3]	3,612	1,836	61	653	1,062

[1] Net volume, International 1/4-inch rule.

[2] Data for the Eldorado National Forest not available.

[3] Numbers may not add to totals due to rounding.

Table 15--*Volume of growing stock and sawtimber on commercial forest land, by ownership class and by softwoods and hardwoods, Sacramento area, California, January 1, 1972*

Ownership classes	Average volume per acre	All species	Softwoods	Hardwoods
	Cubic feet	- - - - - -Million cubic feet- - - - -		
Growing stock:[1]				
National Forest	3,812	8,082	7,909	173
Other public	2,000	122	105	17
Forest industry	3,611	2,358	2,238	120
Farmer and miscellaneous private	2,335	2,480	2,243	236
Total[2]	3,348	13,042	12,243	547
	Board feet	- - - - - -Million board feet- - - - -		
Sawtimber (International 1/4-inch rule):[3]				
National Forest	22,183	47,028	46,568	460
Other public	10,557	644	608	36
Forest industry	20,587	13,443	13,277	166
Farmer and miscellaneous private	12,460	13,233	12,747	485
Total[2]	19,088	74,348	73,200	1,147
Sawtimber (Scribner rule):[4]				
National Forest	19,749	41,867	41,432	435
Other public	8,869	541	506	35
Forest industry	17,685	11,458	11,296	162
Farmer and miscellaneous private	10,456	11,104	10,628	476
Total[2]	16,680	64,970	63,862	1,108

[1] Includes trees 5.0-inch d.b.h. and larger.

[2] Numbers may not add to totals due to rounding.

[3] Includes softwood trees 9.0-inch d.b.h. and larger, and hardwood trees 11.0-inch d.b.h. and larger.

[4] Includes trees 11.0-inch d.b.h. and larger.

Table 16--*Volume of all growing stock on commercial forest land, by county and ownership class, Sacramento area, California, January 1, 1972*

(In million cubic feet)

County	Total	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Butte	885	286	10	361	228
Colusa	47	45	--	--	2
El Dorado	1,865	911	30	471	453
Glenn	444	357	--	77	10
Lake	318	233	--	38	47
Napa	48	--	--	--	48
Nevada	887	389	17	24	457
Placer	1,465	792	29	266	378
Plumas	3,562	2,802	22	248	490
Sacramento	--	—	--	--	--
Sierra	1,537	1,174	4	183	176
Sutter	4	—	--	--	4
Tehama	1,671	924	7	688	52
Yolo	2	—	--	--	2
Yuba	308	169	3	4	132
Total[1/]	13,042	8,082	122	2,358	2,480

[1/] Numbers may not add to totals due to rounding.

Table 17--*Volume of all sawtimber on commercial forest land, by county and ownership class, Sacramento area, California, January 1, 1972*

(International 1/4-inch rule)

County	Total	National Forest	Other public	Forest industry	Farmer and miscellaneous private
	- - - - - - - - - - - - - - - - -Million board feet- - - - - - - - - - - - -				
Butte	4,356	1,573	56	1,665	1,062
Colusa	265	255	--	--	10
El Dorado	11,220	5,765	155	2,869	2,431
Glenn	2,613	2,064	--	498	51
Lake	1,772	1,293	--	251	228
Napa	227	--	--	--	227
Nevada	4,895	2,171	76	148	2,500
Placer	8,871	4,895	159	1,640	2,177
Plumas	19,787	15,763	130	1,339	2,555
Sacramento	--	--	--	--	--
Sierra	8,935	6,768	17	1,156	994
Sutter	21	--	--	--	21
Tehama	9,696	5,542	38	3,854	262
Yolo	9	--	--	--	9
Yuba	1,680	938	14	22	706
Total[1/]	74,348	47,028	644	13,443	13,233

[1/] Numbers may not add to totals due to rounding.

Table 18--*Volume of all sawtimber on commercial forest land, by county and ownership class, Sacramento area, California, January 1, 1972*

(Scribner rule)

County	Total	National Forest	Other public	Forest industry	Farmer and miscellaneous private
	- - - - - - - - - - - - - - -Million board feet- - - - - - - - - - - - - - -				
Butte	3,648	1,337	48	1,383	880
Colusa	236	227	--	--	9
El Dorado	9,850	5,208	130	2,475	2,037
Glenn	2,361	1,880	--	438	43
Lake	1,588	1,180	--	219	189
Napa	194	--	--	--	194
Nevada	4,215	1,898	59	130	2,128
Placer	7,842	4,431	134	1,382	1,895
Plumas	17,108	13,823	112	1,124	2,049
Sacramento	--	--	--	--	--
Sierra	7,816	5,935	13	1,020	848
Sutter	18	--	--	--	18
Tehama	8,599	5,083	34	3,268	214
Yolo	8	--	--	--	8
Yuba	1,487	865	11	19	592
Total[1/]	64,970	41,867	541	11,458	11,104

[1/] Numbers may not add to totals due to rounding.

Table 19--*Volume of timber on commercial forest land, by class of timber and by softwoods and hardwoods, Sacramento area, California, January 1, 1972*

(In million cubic feet)

Class of timber	All species	Softwoods	Hardwoods
Sawtimber trees:			
Saw log portion	11,562	11,274	288
Upper stem portion	480	[1/] 397	[1/]83
Total	12,042	11,671	371
Poletimber trees	1,000	824	176
All growing-stock trees	13,042	12,495	547
Sound cull trees	165	34	130
Rotten cull trees	168	121	47
Salvable dead trees	107	106	1
All timber[2/]	13,482	12,755	726

[1/] Used relationships from 1968 and 1970 compilation for all of California.

[2/] Numbers may not add to totals due to rounding.

Table 20--*Net volume of softwood growing stock on commercial forest land by diameter and ownership classes, Sacramento area, California, January 1, 1972*

Diameter class	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Inches d.b.h.	- - - - - - - - - - - - -Million cubic feet- - - - - - - - - - - - -				
5.0 - 6.9	217	129	1	41	46
7.0 - 8.9	348	209	1	68	70
9.0 - 10.9	443	260	3	93	87
11.0 - 12.9	510	297	5	91	117
13.0 - 14.9	617	344	7	116	150
15.0 - 16.9	683	391	9	120	163
17.0 - 18.9	692	374	7	128	183
19.0 - 20.9	848	536	9	130	173
21.0 - 28.9	2,703	1,600	32	512	559
29.0 - 38.9	2,765	1,849	26	490	400
39.0 and larger	2,671	1,922	4	449	296
Total[1/]	12,495	7,909	105	2,238	2,243

[1/] Numbers may not add to totals due to rounding.

Table 21--*Net volume of softwood sawtimber on commercial forest land by diameter and ownership classes, Sacramento area, California, January 1, 1972*

(International 1/4-inch rule)

Diameter class	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Inches d.b.h.	- - - - - - - - - - - - - -Million board feet- - - - - - - - - - - -				
9.0 - 10.9	1,568	874	10	365	319
11.0 - 12.9	2,314	1,359	22	409	524
13.0 - 14.9	3,156	1,780	36	587	753
15.0 - 16.9	3,686	2,095	46	651	894
17.0 - 18.9	3,888	2,046	41	730	1,071
19.0 - 20.9	5,086	3,201	57	784	1,044
21.0 - 28.9	16,776	9,748	200	3,316	3,512
29.0 - 38.9	18,228	12,137	168	3,310	2,613
39.0 and larger	18,500	13,329	28	3,126	2,017
Total[1/]	73,200	46,568	608	13,277	12,747

[1/] Numbers may not add to totals due to rounding.

Table 22--*Net volume of softwood sawtimber on commercial forest land by diameter and ownership classes, Sacramento area, California, January 1, 1972*

(Scribner rule)

Diameter class	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Inches d.b.h.	- - - - - - - - - - - - - -Million board feet- - - - - - - - - - - -				
9.0 - 10.9	--	--	--	--	--
11.0 - 12.9	1,552	951	11	267	323
13.0 - 14.9	2,340	1,353	25	427	535
15.0 - 16.9	2,918	1,693	34	505	686
17.0 - 18.9	3,216	1,720	34	594	868
19.0 - 20.9	4,356	2,783	47	655	871
21.0 - 28.9	14,904	8,750	175	2,904	3,075
29.0 - 38.9	16,934	11,387	154	3,018	2,375
39.0 and larger	17,644	12,796	27	2,926	1,895
Total[1/]	63,862	41,432	506	11,296	10,628

[1/] Numbers may not add to totals due to rounding.

Table 23--*Volume of growing stock on commercial forest land by species and ownership class, Sacramento area, California, Janaury 1, 1972*

(In million cubic feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	2,124	1,317	33	434	340
Red fir[1]	1,542	988	1	205	348
Red fir[1]	1,542	988	1	205	348
Grand fir	12	12	--	--	--
Ponderosa pine	2,108	1,185	32	500	391
Jeffrey pine	742	566	4	21	151
Sugar pine	1,181	797	8	285	91
Western white pine	87	50	--	16	21
Lodgepole pine	272	108	--	54	110
Knobcone pine	1	1	--	--	--
Mountain hemlock	12	7	--	5	--
Redwood--old growth	2	--	--	--	2
Redwood--young growth		5	--	--	--
Incense-cedar	808	342	11	184	271
Total[2]	12,495	7,909	105	2,238	2,243
Hardwoods:					
Red alder	3	1	--	--	2
White alder	6	2	--	[3]	4
Oregon ash	[3]	[3]	--	--	[3]
Quaking aspen	6	5	--	--	1
Black cottonwood	12	1	1	--	10
Bigleaf maple	5	2	--	--	3
California black oak	354	127	8	67	152
Miscellaneous oaks[4]	129	26	6	53	44
Golden chinkapin	1	1	--	--	--
Pacific madrone	29	6	2	--	21
Other hardwoods	1	1	--	--	--
Total[2]	547	173	17	120	236
All species[2]	13,042	8,082	122	2,358	2,480

---

[1] Includes California and Shasta red firs.

[2] Numbers may not add to totals due to rounding.

[3] Less than 500,000 cubic feet.

[4] Includes California live oak, California white oak, canyon live oak, and tanoak.

Table 24--*Volume of sawtimber on commercial forest land by species and ownership class, Sacramento area, California, January 1, 1972*

(International 1/4-inch rule)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
	- - - - - - - - - - - - -	-Million board feet-	- - - - - - - - - - - - -		
Softwoods:					
Douglas-fir	12,259	7,678	200	2,518	1,863
White fir	21,135	14,432	92	3,411	3,200
Red fir[1]	9,567	6,151	4	1,247	2,165
Grand fir	61	61	--	--	--
Ponderosa pine	12,353	7,185	183	2,846	2,139
Jeffrey pine	4,121	3,215	24	135	747
Sugar pine	7,516	5,170	49	1,768	529
Western white pine	533	309	--	98	126
Lodgepole pine	1,411	469	--	330	612
Knobcone pine	1	1	--	--	--
Mountain hemlock	65	39	--	26	--
Redwood	32	--	--	--	32
Incense-cedar	4,147	1,858	57	898	1,334
Total	73,200	46,568	608	13,277	12,747
Hardwoods:					
Red alder	11	3	--	--	8
White alder	15	6	--	--	9
Oregon ash	1	1	--	--	--
Quaking aspen	15	10	--	--	5
Black cottonwood	41	4	5	--	32
Bigleaf maple	6	2	--	--	4
California black oak	762	300	17	133	312
Miscellaneous oaks[2]	230	111	11	32	76
Golden chinkapin	3	3	--	--	--
Pacific madrone	57	15	3	--	39
Other hardwoods	4	4	--	--	--
Total	1,147	460	36	166	485
All species[3]	74,348	47,028	644	13,443	13,233

[1] Includes California and Shasta red firs.

[2] Includes California live oak, California white oak, canyon live oak, and tanoak.

[3] Numbers may not add to totals due to rounding.

Table 25--*Volume of sawtimber on commercial forest land, by species and ownership class, Sacramento area, California, January 1, 1972*

(Scribner rule)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
	- - - - - - - - - - - -	- - - - - -Million board feet-	- - - - - -	- - - - - -	- - - - - - - - - - - -
Softwoods:					
Douglas-fir	10,879	7,022	171	2,127	1,559
White fir	18,039	12,428	74	2,878	2,659
Red fir[1]	8,367	5,365	3	1,073	1,926
Grand fir	56	56	--	--	--
Ponderosa pine	10,988	6,668	153	2,412	1,755
Jeffrey pine	3,628	2,914	17	121	576
Sugar pine	6,841	4,763	43	1,578	457
Western white pine	476	274	--	90	112
Lodgepole pine	1,200	395	--	288	517
Knobcone pine	1	1	--	--	--
Mountain hemlock	53	31	--	22	--
Redwood	27	--	--	--	27
Incense-cedar	3,310	1,517	44	708	1,041
Total	63,862	41,432	506	11,296	10,628
Hardwoods:					
Red alder	11	3	--	--	8
White alder	15	6	--	--	9
Oregon ash	1	1	--	--	--
Quaking aspen	15	10	--	--	5
Black cottonwood	41	4	5	--	32
Bigleaf maple	7	2	--	--	5
California black oak	740	287	16	131	306
Miscellaneous oaks[2]	215	100	10	31	74
Golden chinkapin	3	3	--	--	--
Pacific madrone	55	14	3	--	38
Other hardwoods	4	4	--	--	--
Total	1,108	435	35	162	476
All species[3]	64,970	41,867	541	11,458	11,104

[1] Includes California and Shasta red firs.

[2] Includes California live oak, California white oak, canyon live oak, and tanoak.

[3] Numbers may not add to totals due to rounding.

Table 26--*Volume of growing stock on commercial forest land, by species and diameter class, Sacramento area, California, January 1, 1972*

(In million cubic feet)

Species	Diameter class (inches at breast height)											
	All classes	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger
Softwoods:												
Douglas-fir	2,124	45	64	79	82	91	105	102	109	393	479	577
White fir	3,602	83	136	165	185	220	227	243	294	797	748	506
Red fir1/	1,542	15	23	31	43	50	60	74	92	363	395	395
Grand fir	12	1	1	--	--	--	--	--	--	2	8	--
Ponderosa pine	2,108	19	42	62	85	114	127	117	170	539	454	377
Jeffrey pine	745	15	24	33	30	44	46	41	54	134	166	156
Sugar pine	1,181	7	14	13	21	22	35	39	50	213	268	495
Western white pine	87	2/	2/	1	2	3	2	4	4	24	21	25
Lodgepole pine	272	5	9	15	18	18	24	21	22	73	57	7
Knobcone pine	1	--	2/	--	1	--	--	--	--	--	--	--
Mountain hemlock	12	2/	2/	1	1	1	1	2/	2	4	2	2/
Redwood	7	--	--	--	1	--	2/	1	1	3	1	--
Incense-cedar	808	28	35	42	40	54	54	50	52	157	163	133
Total	12,495	217	348	443	510	617	683	692	848	2,703	2,765	2,671
Hardwoods:												
Red alder	3	--	2/	2/	--	--	--	--	--	1	2	--
White alder	6	2/	1	1	2/	2	--	--	--	2	--	--
Oregon ash	2/	--	2/	--	--	--	2/	--	--	--	--	--
Quaking aspen	6	2/	1	1	2/	1	1	1	1	2/	--	--
Black cottonwood	12	--	--	2/	2/	2/	--	1	2	7	1	1
Bigleaf maple	5	1	1	1	2/	2/	1	1	--	2/	--	--
California black oak	354	24	38	38	34	29	27	31	23	70	33	9
Miscellaneous oaks3/	129	15	20	27	15	10	6	7	6	11	7	2
Golden chinkapin	1	2/	--	1	--	2/	2/	--	2/	2/	2/	--
Pacific madrone	29	1	2	2	3	6	7	2	3	2	1	--
Other hardwoods	1	--	--	--	2/	1	2/	2/	--	--	--	--
Total	547	42	64	72	52	49	42	43	35	93	44	12
All species4/	13,042	259	412	515	562	666	725	735	883	2,796	2,809	2,683

1/ Includes California and Shasta red firs.

2/ Less than 500,000 cubic feet.

3/ Includes California live oak, California white oak, canyon live oak, and tanoak.

4/ Numbers may not add to totals due to rounding.

Table 27--*Volume of sawtimber on commercial forest land, by species and diameter class, Sacramento area, California, January 1, 1972*

(International 1/4-inch rule)

Species	Diameter class (inches at breast height)									
	All classes	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger
	Million board feet									
Softwoods:										
Douglas-fir	12,259	231	332	419	542	569	627	2,417	3,128	3,994
White fir	21,135	538	875	1,222	1,334	1,451	1,815	5,210	5,138	3,551
Red fir[1]	9,567	145	225	291	360	444	559	2,254	2,591	2,699
Grand fir	61	--	--	--	--	--	--	12	49	--
Ponderosa pine	12,353	214	359	534	630	613	1,011	3,263	3,020	2,708
Jeffrey pine	4,121	146	129	190	207	193	311	760	1,070	1,115
Sugar pine	7,516	41	90	118	203	225	306	1,340	1,748	3,443
Western white pine	533	3	8	13	15	19	23	151	135	164
Lodgepole pine	1,411	42	72	81	115	108	126	446	371	46
Knobcone pine	1	--	1	--	--	--	--	--	--	--
Mountain hemlock	65	4	5	5	5	2	6	21	15	2
Redwood	32	--	2	--	2	6	5	15	3	--
Incense-cedar	4,147	203	216	282	272	259	295	885	959	777
Total	73,200	1,568	2,314	3,156	3,686	3,888	5,086	16,776	18,228	18,500
Hardwoods:										
Red alder	11	--	--	--	--	--	--	3	8	--
White alder	16	--	[2]	5	--	--	--	11	--	--
Oregon ash	1	--	--	--	1	--	--	--	--	--
Quaking aspen	15	--	[2]	4	4	5	1	[2]	--	--
Black cottonwood	41	--	[2]	2	--	2	5	25	6	1
Bigleaf maple	7	--	[2]	1	2	1	--	2	--	--
California black oak	762	--	68	66	66	83	80	225	134	41
Miscellaneous oaks[3]	230	--	30	29	18	28	31	52	29	12
Golden chinkapin	3	--	--	[2]	[2]	--	1	1	1	--
Pacific madrone	57	--	6	12	16	5	11	6	2	--
Other hardwoods	4	--	[2]	2	1	1	--	--	--	--
Total	1,147	--	103	122	111	124	127	325	180	55
All species[4]	74,348	1,568	2,417	3,278	3,797	4,012	5,213	17,101	18,408	18,555

[1] Includes California and Shasta red firs.

[2] Less than 500,000 board feet.

[3] Includes California live oak, California white oak, canyon live oak, and tanoak.

[4] Numbers may not add to totals due to rounding.

Table 28--*Volume of sawtimber on commercial forest land, by species and diameter class, Sacramento area, California, January 1, [illegible]*

(Scribner rule)

Species	Diameter class (inches at breast height)									
	All classes	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger
	-Million board feet-									
Softwoods:										
Douglas-fir	10,879	—	241	317	428	463	524	2,123	2,924	3,859
White fir	18,039	--	651	947	1,072	1,198	1,540	4,565	4,713	3,353
Red fir1/	8,367	--	154	216	286	368	476	1,979	2,371	2,518
Grand fir	56	--	--	--	--	--	--	11	45	--
Ponderosa pine	10,988	—	192	380	509	529	903	3,017	2,868	2,590
Jeffrey pine	3,628	--	61	130	164	165	283	720	1,032	1,074
Sugar pine	6,841	--	55	81	149	177	252	1,173	1,629	3,326
Western white pine	476	--	4	9	10	15	19	131	127	159
Lodgepole pine	1,200	--	57	66	96	93	109	400	336	42
Knobcone pine	1	--	1	--	--	--	--	--	--	--
Mountain hemlock	53	—	2	4	3	2	6	19	15	2
Redwood--old growth	6	--	--	--	2	--	--	2	2	--
Redwood--young growth	21	--	1	—	--	4	4	11	--	--
Incense-cedar	3,310	--	131	190	200	203	241	755	871	719
Total	63,862	--	1,552	2,340	2,918	3,216	4,356	14,904	16,934	17,644
Hardwoods:										
Red alder	11	--	--	--	--	--	--	3	8	—
White alder	15	--	2/	5	--	--	--	10	—	--
Oregon ash	1	--	--	--	1	--	—	—	--	--
Quaking aspen	15	--	1	4	4	5	1	2/	--	--
Black cottonwood	41	--	2/	2	--	2	5	24	6	1
Bigleaf maple	6	--	2/	1	2	1	--	2	--	--
California black oak	740	--	65	64	64	80	76	220	131	41
Miscellaneous oaks3/	215	--	28	28	18	25	28	49	28	12
Golden chinkapin	3	—	--	2/	1	--	2/	1	1	--
Pacific madrone	55	—	6	12	16	5	10	6	2	--
Other hardwoods	4	--	2/	1	1	1	--	—	--	--
Total	1,108	--	100	117	107	120	120	316	175	53
All species4/	64,970	--	1,652	2,457	3,025	3,336	4,476	15,220	17,109	17,697

---

[1] Includes California and Shasta red firs.

[2] Less than 500,000 board feet.

[3] Includes California live oak, California white oak, canyon live oak, and tanoak.

[4] Numbers may not add to totals due to rounding.

Table 29--*Net annual growth of growing stock and sawtimber on commercial forest land, by ownership class and by softwoods and hardwoods, Sacramento area, California, January 1, 1972*

Ownership class	Average volume per acre	All species	Softwoods	Hardwoods
	Cubic feet	- - - - -Thousand cubic feet- - - - - -		
Growing stock:[1]				
National Forest	50	106,894	102,935	3,959
Other public	49	3,018	2,251	767
Forest industry	63	40,951	37,589	3,362
Farmer and miscellaneous private	51	54,650	50,323	4,327
Total	53	205,513	193,098	12,415
	Board feet	- - - - -Thousand board feet- - - - -		
Sawtimber (International 1/4-inch rule):[2]				
National Forest	305	646,465	639,950	6,515
Other public	254	15,481	14,845	636
Forest industry	417	272,205	269,121	3,084
Farmer and miscellaneous private	293	311,338	303,683	7,655
Total	320	1,245,489	1,227,599	17,890
Sawtimber (Scribner rule):[3]				
National Forest	245	519,981	513,640	6,341
Other public	171	10,435	9,804	631
Forest industry	352	230,156	227,108	3,048
Farmer and miscellaneous private	266	282,231	274,654	7,577
Total	268	1,042,803	1,025,206	17,597

---

[1] Includes trees 5.0-inch d.b.h. and larger.

[2] Includes softwood trees 9.0-inch d.b.h. and larger, and hardwood trees 11.0-inch d.b.h. and larger.

[3] Includes trees 11.0-inch d.b.h. and larger.

Table 30--*Net annual growth of growing stock on commercial forest land by species and ownership class, Sacramento area, California, Janaury 1, 1972*

(In thousand cubic feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	29,181	13,498	[1]-223	6,406	9,500
White fir	60,668	43,912	941	7,532	8,283
Red fir[2]	17,565	10,991	--	3,245	3,329
Grand fir	135	135	--	--	--
Ponderosa pine	38,566	12,919	1,231	10,260	14,156
Jeffrey pine	13,325	8,711	133	377	4,104
Sugar pine	16,291	7,051	84	5,854	3,302
Western white pine	1,333	442	--	321	570
Lodgepole pine	2,868	1,732	--	729	407
Mountain hemlock	115	115	--	--	--
Redwood--young growth	202	--	--	--	202
Incense-cedar	12,850	3,429	85	2,865	6,471
Total	193,098	102,935	2,251	37,589	50,323
Hardwoods:					
Red alder	39	27	--	--	12
White alder	80	67	--	--	13
Quaking aspen	215	198	--	--	17
Black cottonwood	23	2	15	--	6
Bigleaf maple	174	117	--	--	57
California black oak	7,753	3,028	549	1,121	3,055
Miscellaneous oaks[3]	3,529	417	37	2,241	834
Golden chinkapin	23	23	--	--	--
Pacific madrone	579	80	166	--	333
Total	12,415	3,959	767	3,362	4,327
All species[4]	205,513	106,894	3,018	40,951	54,650

---

[1] Negative net annual growth is the result of net annual mortality exceeding gross annual growth.

[2] Includes California and Shasta red firs.

[3] Includes California live oak, California white oak, canyon live oak, and tanoak.

[4] Numbers may not add to totals due to rounding.

Table 31--*Net annual growth of sawtimber on commercial forest land, by species and ownership class, Sacramento area, California, January 1, 1972*

(International 1/4-inch Rule)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
	- - - - - - - - - - - - -Thousand board feet-				- - - - - - - - - - - -
Softwoods:					
Douglas-fir	180,015	78,760	1,454	52,035	47,766
White fir	385,119	262,017	3,744	58,172	61,186
Red fir[1]	114,160	68,234	--	24,725	21,201
Grand fir	416	416	--	--	--
Ponderosa pine	266,183	91,032	7,451	75,087	92,613
Jeffrey pine	79,710	52,367	786	2,811	23,746
Sugar pine	109,260	50,446	652	39,360	18,802
Western white pine	9,214	3,401	--	2,140	3,673
Lodgepole pine	20,628	9,437	--	4,663	6,528
Mountain hemlock	1,421	1,421	--	--	--
Redwood--young growth	1,319	--	--	--	1,319
Incense-cedar	60,153	22,419	758	10,128	26,848
Total	1,227,599	639,950	14,845	269,121	303,683
Hardwoods:					
Red alder	111	38	--	--	73
White alder	243	169	--	--	74
Quaking aspen	160	72	--	--	88
Black cottonwood	152	12	71	--	69
Bigleaf maple	164	43	--	--	121
California black oak	12,246	5,095	270	1,787	5,094
Miscellaneous oaks[2]	3,736	899	55	1,297	1,485
Golden chinkapin	53	53	--	--	--
Pacific madrone	1,024	134	240	--	650
Total	17,890	6,515	636	3,084	7,655
All species[3]	1,245,489	646,465	15,481	272,205	311,338

[1] Includes California and Shasta red firs.

[2] Includes California live oak, California white oak, canyon live oak, and tanoak.

[3] Numbers may not add to totals due to rounding.

Table 32--*Net annual growth of sawtimber on commercial forest land, by species and ownership class, Sacramento area, California January 1, 1972*

(Scribner rule)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
	- - - - - - - - - - - -	- - - - - - -Thousand	board feet- - - - - - -	- - - - - - - - - - - -	- - - - - - - - - - - -
Softwoods:					
Douglas-fir	141,295	60,655	[1]-1,577	41,947	40,270
White fir	333,161	218,163	3,167	47,256	64,575
Red fir[2]	93,963	57,555	--	16,922	19,486
Grand fir	380	380	--	--	--
Ponderosa pine	224,642	73,184	6,355	64,630	80,473
Jeffrey pine	60,010	36,316	519	2,327	20,848
Sugar pine	94,528	40,903	685	36,928	16,112
Western white pine	8,549	2,966	--	2,015	3,568
Lodgepole pine	13,381	7,076	--	3,839	2,466
Mountain hemlock	528	528	--	--	--
Redwood--young growth	1,152	--	--	--	1,152
Incense-cedar	53,619	16,014	655	11,244	25,706
Total	1,025,206	513,640	9,804	227,108	274,654
Hardwoods:					
Red alder	112	40	--	--	72
White alder	242	168	--	--	74
Quaking aspen	158	72	--	--	86
Black cottonwood	146	5	70	--	71
Bigleaf maple	165	44	--	--	121
California black oak	12,039	4,961	270	1,770	5,038
Miscellaneous oaks[3]	3,670	867	55	1,278	1,470
Golden chinkapin	54	54	--	--	--
Pacific madrone	1,010	130	236	--	644
Total	17,597	6,341	631	3,048	7,577
All species[4]	1,042,803	519,981	10,435	230,156	282,231

---

[1] Negative net annual growth is the result of net annual mortality exceeding gross annual growth.

[2] Includes California and Shasta red firs.

[3] Includes California live oak, California white oak, canyon live oak, and tanoak.

[4] Numbers may not add to totals due to rounding.

Table 33--*Average annual mortality of growing stock on commercial forest land, by species and ownership class, Sacramento area California, January 1, 1972*

(In thousand cubic feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	5,010	2,955	668	1,049	338
White fir	11,015	3,863	--	3,482	3,670
Red fir[1]	5,828	4,756	--	289	783
Ponderosa pine	4,184	948	9	1,339	1,888
Jeffrey pine	1,225	1,148	--	77	--
Sugar pine	1,089	309	59	721	--
Western white pine	345	142	--	--	203
Lodgepole pine	1,876	526	--	199	1,151
Incense-cedar	1,588	576	75	401	536
Total	32,158	15,223	810	7,557	8,568
Hardwoods:					
Quaking aspen	60	60	--	--	--
Black cottonwood	76	--	--	--	76
California black oak	442	370	--	--	72
Canyon live oak	145	--	--	--	145
Pacific madrone	62	62	--	--	--
Total	785	492	--	--	293
All species[2]	32,943	15,715	810	7,557	8,861

[1] Includes California and Shasta red firs.

[2] Numbers may not add to totals due to rounding.

Table 34--*Average annual mortality of sawtimber on commercial forest land, by species and ownership class, Sacramento area, California, January 1, 1972*

(International 1/4-inch rule)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
	- - - - - - - - - - -	- - - - - - -Thousand	board feet- - - - - - -	- - - - - - -	- - - - - - - - -
Softwoods:					
Douglas-fir	29,748	18,423	4,300	5,149	1,876
White fir	65,041	22,732	--	21,091	21,218
Red fir[1]	26,418	20,796	--	1,211	4,411
Ponderosa pine	23,812	13,081	--	3,146	7,585
Jeffrey pine	2,999	2,999	--	--	--
Sugar pine	10,021	6,940	300	2,781	--
Western white pine	2,163	888	--	--	1,275
Lodgepole pine	9,349	1,709	--	1,318	6,322
Incense-cedar	6,300	3,303	76	1,671	1,250
Total	175,850	90,870	4,676	36,367	43,937
Hardwoods:					
Quaking aspen	172	172	--	--	--
Black cottonwood	287	--	--	--	287
California black oak	1,609	1,517	--	--	92
Pacific madrone	102	102	--	--	--
Total	2,170	1,791	--	--	379
All species[2]	178,020	92,661	4,676	36,367	44,316

[1] Includes California and Shasta red firs.

[2] Numbers may not add to totals due to rounding.

Table 35--*Average annual mortality of sawtimber on commercial forest land by species and ownership class, Sacramento area, California, January 1, 1972*

(Scribner rule)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
	- - - - - - - - - - - - -	Thousand board feet	- - - - - - - - - - - - -		
Softwoods:					
Douglas-fir	26,877	17,118	3,925	4,365	1,469
White fir	54,657	19,688	--	17,606	17,363
Red fir[1]	21,895	17,290	--	1,021	3,584
Ponderosa pine	19,139	11,996	--	2,028	5,115
Jeffrey pine	2,586	2,586	--	--	--
Sugar pine	8,451	6,261	192	1,998	--
Western white pine	1,838	703	--	--	1,135
Lodgepole pine	7,371	1,346	--	1,178	4,847
Incense-cedar	4,432	2,341	--	1,161	930
Total	147,246	79,330	4,117	29,357	34,442
Hardwoods:					
Quaking aspen	167	167	--	--	--
Black cottonwood	283	--	--	--	283
California black oak	1,593	1,503	--	--	90
Pacific madrone	100	100	--	--	--
Total	2,143	1,770	--	--	373
All species[2]	149,389	81,100	4,117	29,357	34,815

---

[1] Includes California and Shasta red firs.

[2] Numbers may not add to totals due to rounding.

Table 36--*Average annual mortality of growing stock and sawtimber on commercial forest land outside National Forests, by cause of death and by softwoods and hardwoods, Sacramento area, California*

Cause of death	Growing stock			Sawtimber[1]			Sawtimber[2]		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
	- - - - -Thousand cubic feet- - - - -			- - - - - - - - - - - - - - - - - - -Thousand board feet- - - - - - - - - - - - - - - - - -					
Fire	1,444	1,259	185	5,343	5,343	--	4,038	4,038	--
Insects	2,345	2,345	--	11,401	11,401	--	8,915	8,915	--
Disease	756	756	--	4,012	4,012	--	3,264	3,624	--
Animals	36	36	--	139	139	--	--	--	--
Weather	4,407	4,299	108	17,242	16,863	379	10,826	10,453	373
Suppression	534	534	--	654	654	--	192	192	--
Logging	273	273	--	1,050	1,050	--	827	827	--
Unknown	7,433	7,433	--	45,517	45,517	--	40,227	40,227	--
Total	17,229	16,936	293	85,359	84,980	379	68,290	67,917	373

[1] International 1/4-inch rule.

[2] Scribner rule.

Table 37--*Net volume of salvable dead sawtimber on commercial forest land outside National Forests, by volume per acre class and by county, Sacramento area, California*

(In thousand cubic feet)

Volume per acre class	Butte	West Sacramento	El Dorado	Nevada group	Placer	Plumas	Sacramento	Tehama
1- 199 cu. ft.	2,997	2,608	4,612	6,317	3,167	5,035	--	3,597
200- 499 cu. ft.	--	461	4,263	755	8,070	3,770	--	1,006
500- 999 cu. ft.	--	--	3,702	3,937	4,219	3,537	--	--
1,000-1,999 cu. ft.	--	--	--	--	--	--	--	--
2,000+	--	--	--	--	--	--	--	--
Total[1]	2,997	3,069	12,577	11,009	15,456	12,342	--	4,603

[1] Numbers may not add to totals due to rounding.

Table 38--*Net volume of salvable dead sawtimber on commercial forest land outside National Forests, by volume per acre class and by county, Sacramento area, California*

(International 1/4-inch rule)

Volume per acre class	Butte	West Sacramento	El Dorado	Nevada group	Placer	Plumas	Sacramento	Tehama
	- - - - - - - -	- - - - - - - -	- - - - - - - -	- - - Thousand board feet	- - - - - - - -	- - - - - - - -	- - - - - - - -	- - - - - - - -
1- 499 bd. ft.	5,395	5,049	4,551	7,617	--	6,422	--	7,007
500- 999 bd. ft.	11,805	6,540	10,993	17,212	13,918	20,230	--	13,037
1,000-2,499 bd. ft.	--	--	38,614	17,661	17,661	10,639	--	6,469
2,500-4,999 bd. ft.	--	3,404	--	26,199	54,250	32,252	--	--
5,000-9,999 bd. ft.	--	--	26,998	--	--	--	--	--
10,000+	--	--	--	--	--	--	--	--
Total[1]	17,200	14,993	81,156	68,689	103,356	69,543	--	26,513

[1] Numbers may not add to totals due to rounding.

Table 39--*Net volume of salvable dead sawtimber on commercial forest land outside National Forests, by volume per acre class and by county, Sacramento area, California*

(Scribner rule)

Volume per acre class	Butte	West Sacramento	El Dorado	Nevada group	Placer	Plumas	Sacramento	Tehama
	- - - - - - - -	- - - - - - - -	- - - - - - - -	- - - Thousand board feet	- - - - - - - -	- - - - - - - -	- - - - - - - -	- - - - - - - -
1- 199 bd. ft.	6,169	8,883	4,027	9,178	--	6,306	--	7,520
500- 999 bd. ft.	7,310	--	14,255	11,392	12,003	14,118	--	8,098
1,000-2,499 bd. ft.	--	--	27,364	15,948	47,593	18,011	--	5,675
2,500-4,999 bd. ft.	--	3,100	--	24,731	34,240	17,856	--	--
5,000-9,999 bd. ft.	--	--	25,577	--	--	--	--	--
10,000+	--	--	--	--	--	--	--	--
Total[1]	13,479	11,983	71,222	61,249	93,836	56,290	--	21,293

[1] Numbers may not add to totals due to rounding.

Table 40--Reported timber production by county in the Sacramento area of California and for all of California, 1947-1973

(In thousand board feet)[1]

Year	Butte	Colusa	El Dorado	Glenn	Lake	Napa	Nevada	Placer	Plumas	Sierra	Sutter	Tehama	Yolo	Yuba	Total Sacramento	Total all California
1947	233,319	2/	226,908	900	77,794	2/	80,959	40,074	236,732	67,046	2/	22,500	2/	40,759	1,026,991	3,185,995
1948	192,877	2/	243,794	2/	24,500	--	36,841	44,901	187,743	45,295	2/	96,344	2/	74,119	946,414	3,983,213
1949	136,276	2/	155,481	2/	32,491	--	71,542	53,025	344,095	42,184	2/	91,758	2/	52,349	979,201	3,795,252
1950	105,352	2/	201,206	6,229	18,100	4/180	98,343	87,229	348,368	41,627	2/	128,143	2/	53,890	1,088,667	4,303,011
1951	126,607	2/	240,251	31,750	21,351	--	97,024	137,199	318,862	60,128	2/	74,472	2/	31,090	1,138,734	4,984,288
1952	136,523	2/	251,101	25,914	29,874	4/620	103,593	106,424	419,195	65,162	2/	71,730	2/	40,348	1,250,484	5,057,036
1953	172,600	3/	213,380	56,849	3/19,732	--	151,017	110,750	401,504	99,583	2/	82,868	2/	33,129	1,341,412	5,990,088
1954	129,779	3/	150,456	28,750	3/20,890	4/719	132,739	110,176	276,840	118,598	2/	120,967	2/	57,152	1,147,066	5,600,310
1955	124,134	3/	228,621	34,682	3/34,448	4/10,010	126,285	98,526	289,093	133,456	2/	81,540	2/	44,119	1,204,914	6,014,939
1956	136,065	3/	213,194	51,377	3/17,180	4/5,256	120,199	111,087	300,478	71,400	6/23,055	114,383	2/	45,797	1,209,471	5,861,634
1957	115,381	3/	154,576	43,872	3/39,472	4/2,595	94,480	57,732	268,461	70,195	6/43,589	103,611	2/	42,399	1,036,363	5,346,521
1958	102,033	3/	170,756	32,662	3/40,761	4/8,643	67,292	79,053	213,514	87,452	6/28,024	141,205	2/	49,621	1,021,016	5,675,392
1959	104,890	3/	218,442	40,944	3/30,483	4/25,906	70,246	117,039	211,610	83,905	2/	102,104	2/	67,342	1,072,911	5,886,061
1960	144,113	3/	336,824	39,968	3/34,883	4/9,165	64,442	74,283	179,712	99,594	2/	146,067	2/	36,500	1,165,551	5,136,649
1961	53,319	3/	197,450	52,681	3/45,876	3/3,890	71,692	182,333	185,881	130,170	2/	155,255	2/	60,695	1,139,242	5,342,250
1962	43,588	3/	189,009	66,889	3/11,723	4/1,575	75,108	111,630	215,451	114,622	2/	157,053	2/	60,022	1,046,670	5,538,928
1963	50,329	3/	160,758	45,270	3/19,209	5/9,076	70,120	139,298	250,195	116,168	2/	135,291	2/	26,555	1,022,269	5,461,046
1964	65,721	3/	135,562	48,617	3/36,822	5/2,095	42,768	138,399	214,741	122,270	2/	138,425	2/	35,668	981,088	5,476,265
1965	55,796	3/	199,995	56,305	3/55,597	5/4,021	54,986	95,977	173,383	117,886	2/	140,914	2/	50,128	1,004,988	5,271,234
1966	49,701	3/	233,003	51,020	3/71,877	5/948	59,186	113,215	221,345	165,847	2/	107,365	2/	38,111	1,111,618	5,008,318
1967	69,121	3/	197,264	31,027	3/69,753	5/2	61,420	84,723	250,016	121,843	2/	127,880	2/	66,616	1,079,665	5,062,021
1968	64,220	3/	210,426	22,672	3/49,475	5/117	73,735	95,271	231,957	143,426	2/	139,852	2/	48,933	1,080,084	5,343,898
1969	28,267	3/	253,622	58,494	3/3,676	5/8	54,799	103,607	217,743	84,534	2/	158,906	2/	43,835	1,007,491	5,000,596
1970	44,867	3/	259,525	49,494	3/37,330	5/341	52,241	113,971	157,462	46,243	2/	179,551	2/	41,344	982,369	4,565,827
1971	61,000	3/	206,324	42,481	3/41,562	5/690	75,782	118,170	238,915	61,602	2/	181,240	2/	30,095	1,057,861	4,789,617
1972	48,951	3/	194,946	54,376	3/40,087	5/105	79,491	126,715	286,659	92,198	2/	161,119	2/	25,068	1,109,715	5,000,507
1973	48,868	3/	197,163	60,975	3/43,271	--	62,624	120,056	305,437	73,748	2/	151,732	2/	39,829	1,103,703	4,923,488

---

[1] Source: "Production of California timber operators." State Forest Notes. Published annually by California Division of Forestry. Various log rules are used in California; no attempt was made to convert the data to a common base. However, the majority of the timber industry in Sacramento used short-log Scribner rule.

[2] Not available.

[3] Colusa and Lake Counties were added together.

[4] Napa and Marin Counties were added together.

[5] Napa, Marin, and Solano Counties were added together.

[6] Alpine, Mono, and Sutter Counties were added together.

Wall, Brian R.
1978. Timber Resources of the Sacramento Area, California, 1972. USDA For. Serv. Resour. Bull. PNW-73, 62 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report summarizes the 1972 timber resource inventory of the Sacramento area, California. Included are detailed tables of forest area, timber volume, growth, mortality, and timber cut and a discussion of the current timber resource and timber industry situation.

KEYWORDS: Forest surveys, statistics (timber), timber statistics, resources (timber), timber resources, California (Sacramento area), Sacramento area--California.

Wall, Brian R.
1978. Timber Resources of the Sacramento Area, California, 1972. USDA For. Serv. Resour. Bull. PNW-73, 62 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report summarizes the 1972 timber resource inventory of the Sacramento area, California. Included are detailed tables of forest area, timber volume, growth, mortality, and timber cut and a discussion of the current timber resource and timber industry situation.

KEYWORDS: Forest surveys, statistics (timber), timber statistics, resources (timber), timber resources, California (Sacramento area), Sacramento area--California.

Wall, Brian R.
1978. Timber Resources of the Sacramento Area, California, 1972. USDA For. Serv. Resour. Bull. PNW-73, 62 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report summarizes the 1972 timber resource inventory of the Sacramento area, California. Included are detailed tables of forest area, timber volume, growth, mortality, and timber cut and a discussion of the current timber resource and timber industry situation.

KEYWORDS: Forest surveys, statistics (timber), timber statistics, resources (timber), timber resources, California (Sacramento area), Sacramento area--California.

Wall, Brian R.
1978. Timber Resources of the Sacramento Area, California, 1972. USDA For. Serv. Resour. Bull. PNW-73, 62 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report summarizes the 1972 timber resource inventory of the Sacramento area, California. Included are detailed tables of forest area, timber volume, growth, mortality, and timber cut and a discussion of the current timber resource and timber industry situation.

KEYWORDS: Forest surveys, statistics (timber), timber statistics, resources (timber), timber resources, California (Sacramento area), Sacramento area--California.

The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Developing and evaluating alternative methods and levels of resource management.
3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research are made available promptly. Project headquarters are at:

Fairbanks, Alaska
Juneau, Alaska
Bend, Oregon
Corvallis, Oregon
La Grande, Oregon
Portland, Oregon
Olympia, Washington
Seattle, Washington
Wenatchee, Washington

Mailing address: Pacific Northwest Forest and Range
Experiment Station
P.O. Box 3141
Portland, Oregon 97208

The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

The U.S. Department of Agriculture is an Equal Opportunity Employer. Applicants for all Department programs will be given equal consideration without regard to race, color, sex or national origin.

A13.[illegible] PNW-74

1978

USDA FOREST SERVICE RESOURCE BULLETIN PNW-74

GOVT. DOCUMENTS
DEPOSITORY ITEM
CLEMSON
LIBRARIES
AUG 2 1978

PROSPECTS FOR SAWTIMBER OUTPUT IN CALIFORNIA'S NORTH COAST, 1975-2000

Daniel D. Oswald

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE
PORTLAND, OREGON

PREFACE

Since completion of this study, 48,000 acres of formerly private timberlands have been added to the Redwood National Park. Because the timber on those lands was considered available for harvest in this study, the timber output scenarios presented herein do not reflect the impacts of Park expansion on timing and magnitude of timber outputs. Although the scenarios would be slightly altered by recognition of the impacts of the Park expansion, the overall results and general conclusions of the study would not be affected.

PROSPECTS FOR SAWTIMBER OUTPUT IN CALIFORNIA'S NORTH COAST, 1975-2000

Reference Abstract

Oswald, Daniel D.
1978. Prospects for sawtimber output in California's North Coast, 1975-2000. USDA For. Serv. Resour. Bull. PNW-74, 20 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report summarizes a study of sawtimber output alternatives for California's North Coast. Eleven "scenarios" of softwood sawtimber output from private lands are presented. The scenarios differ as to assumptions about rates and patterns of harvest and objectives pertaining to levels of output. Prospects for output from public lands are also discussed.

KEYWORDS: Forest product output, supply/demand (forest products), resources (forest), timber resources, California (north coast).

RESEARCH SUMMARY

Resource Bulletin PNW-74

1978

This study was conducted to help determine the outlook for sawtimber output from California's North Coast. The study emphasizes future availability of private timber, which is of most importance to the region's timber economy; the contribution of allowable harvests from public lands is also discussed. The study focuses on softwood sawtimber availability over the next 25 years, a critical time period for the region's softwood-based timber economy.

Resource data for the study came from timber inventories conducted on all private lands in the North Coast in the mid-1960's. These inventories were updated to 1975, and then projected to year 2000 and beyond, on a stand by stand basis.

Study Findings

From 1967 through 1974, output from privately owned timber lands of the North Coast averaged 1.5 billion board feet of softwood sawtimber from growing stock, in addition to 150 million board feet of timber from cull trees and salvage material. During that period, harvest occurred on about 300,000 acres of private land and the region's private softwood sawtimber inventory declined 21 percent, to 26 billion board feet.

A number of "scenarios" were developed for future timber output from private lands of the North Coast. The scenarios differ as to assumptions about ordering of stands for harvest, rates of harvest, and output level objectives. Each represents a potential outcome only within the context of the assumptions associated with it. The scenarios are summarized in table 1.

Scenario I continues the patterns (by stand classes) and rates of harvest experienced from 1967 to 1974. Given that continuation, several of the most important stand classes will be exhausted in the next few years and output will drop sharply starting in 1981. Scenario I is unlikely to occur because, as some types of stands are exhausted, harvest activities will likely shift to other types of stands.

Table 1--*Alternative projections of softwood sawtimber output from private lands*[1] *of California's North Coast, 1975-2000*

(Million board feet)[2]

Scenario[3]	1975	1980	1985	1990	1995	2000
I	1,529	1,507	585	342	162	173
II	1,500	1,500	1,481	1,433	532	24
III	1,483	1,489	1,481	1,524	141	164
IV	1,511	1,498	1,458	1,507	223	278
V	1,216	1,047	895	877	857	885
VI[4]	1,579	1,559	1,537	1,294	80	24
VII[4]	1,564	1,485	1,287	823	469	521
VIII[4]	1,558	1,381	1,479	600	615	536
IX[4]	1,411	1,208	1,086	935	934	928
X	1,494	1,488	1,512	1,494	399	0
XI	1,483	1,489	1,190	1,193	160	194

---

[1] This study assumes that a constant output of 330 million board feet per year from public lands (within and adjoining the North Coast region) will be available to North Coast industries. Output from public timberlands is not included in this table.

[2] Scribner rule.

[3] Each scenario is an alternative projection of sawtimber output resulting from a unique set of assumptions.

[4] This scenario is the sum of two projections.

Scenarios II, III, and IV represent three different approaches to the objective of maintaining current output of private sawtimber for as long as possible. The three scenarios use different sets of priorities and rates of harvest for the sawtimber stands, but the outcomes are similar. In all three scenarios, 1.5 billion board feet of output can be maintained through 1994. Maintenance of output at recent levels however, can be accomplished only by rapid depletion of existing young timber stands, and leads to a precipitous falldown in 1995.

Scenario V demonstrates how the current private sawtimber stocks can be stretched over a 40-year period, thus giving the region's new forest stands time to mature. In essence it involves immediate declines in output as a means of saving sawtimber stocks for future harvest. If private sawtimber output is held at 1.2 billion board feet from 1975 through 1979, and 1.05 billion board feet from 1980 through 1984, adequate sawtimber stocks will remain to maintain sawtimber output at 850 to 900 million board feet until year 2014. This is but one of many possible alternatives that might make the falldown in private sawtimber output less precipitous but more immediate.

Scenarios VI, VII, VIII, and IX recognize differences in species types, major owners, and geographic location and assume that output from one of each set (of two species types, two owners, and two geographic areas) cannot substitute for the other. In all of these scenarios except IX, maintenance of current output was attempted.

Scenario VI indicates that sawtimber output from stands that are predominately redwood can be maintained (at 1 to 1.1 billion board feet) until the late 1980's; however, if so maintained, output will drop to 740 million board feet by 1990 and to less than 100 million board feet by 1995. Output from Douglas-fir (other conifer) sawtimber stands can be maintained at 400-500 million board feet until 1994, but by 1995 all sawtimber stands will have been harvested.

Scenario VII indicates that output from industry lands (1 billion board feet) can be maintained through 1984. From 1985 to 1989, 840 million board feet will be available annually, and by 1990 a decline to one-third of current output levels is indicated. Other private owners can maintain their output at 450-500 million board feet until beyond year 2000.

Scenario VIII develops output profiles separately for Mendocino-Sonoma and Humboldt-Del Norte. In Humboldt-Del Norte, recent output levels can be maintained through 1979; from 1980 through 1989, output can be maintained at 80 to 85 percent of recent levels. By 1990 most sawtimber stocks will be exhausted. In contrast, Mendocino-Sonoma has adequate sawtimber stocks to maintain output at about 500 million board feet to year 2000 and beyond.

Scenario IX is an alternative to VIII in which the Humboldt-Del Norte private output is "stretched" by scheduling immediate declines as a means of providing stocks for the latter part of this century. When combined with the Scenario VIII output for Mendocino-Sonoma, this alternative indicates that with an immediate decline extending to 1989, private sawtimber output in the North Coast might be maintained at about 930 million board feet from 1990 to 2004 (about 60 percent of recent levels).

Scenarios VIII and IX are perhaps the most useful of all the alternatives explored in this study. They indicate that the locus of declines in sawtimber output in the North Coast will be Humboldt-Del Norte. The high rates of harvest and rapidly declining sawtimber stocks in these counties underlie the regional declines in private sawtimber output indicated in the other scenarios.

In all of the scenarios having the objective of maintaining private output at current levels for as long as possible (II, III, IV, VI, VII, VIII, X, and XI), output could be maintained for as long as indicated in the scenarios only by rapidly depleting the young sawtimber stands and residual sawtimber stands, after the large sawtimber stands were gone.

Public Timber

Publicly-owned commercial forests and commercial forests managed in trust by the Bureau of Indian Affairs constitute 25 percent of the region's timber lands. These forests, and public forests adjoining the North Coast Region, have produced 15-20 percent of the sawtimber processed in the region's mills in recent years.

Sawtimber from four National Forests provides raw material for the region's mills. In 1972, these four Forests (Six Rivers, Mendocino, Klamath, and Shasta-Trinity) were the source of 260 million board feet of sawtimber processed in the region. Assuming no significant changes in policy regarding allowable harvests, this is a reasonable estimate of raw material movement from the four forests to the region in the future.

Output from other public lands within the region has been almost 100 million board feet in recent years. However, all three land-managing agencies (State, BLM, BIA) recently reduced their allowable harvests to 71 million board feet (combined). In total, public lands might be expected to provide 330 million board feet annually for the region's timber economy, about 17 percent of recent levels of sawtimber output.

Conclusions

The following general conclusions can be drawn from the study:

1. Output of softwood sawtimber from the North Coast's private timberlands will decline substantially in the next 10 to 15 years.
2. The decline will be centered in Humboldt-Del Norte Counties.
3. No reordering of cutting priorities among the different types of sawtimber stands will have significant impact on the prospective falldown in output.
4. Output will decline in both Douglas-fir and redwood stands.
5. There are not sufficient sawtimber stocks to maintain recent levels of output until new stands, regenerated since the mid-1950's, reach merchantable sawtimber size.
6. Forest industry timberlands will show substantial decreases in output within 10 years; on other private timber lands, output can be maintained throughout the study period, assuming availability for harvest of all of these lands.
7. Output from public lands within and adjoining the region is not likely to offset declines in the private sector.

TABLE OF CONTENTS

Page

INTRODUCTION 1

PROCEDURES 2
  The forest inventory data base 2
  Predictions of stand growth 6
  Development of sawtimber harvest information 7

THE NORTH COAST REGION'S PRIVATE SAWTIMBER RESOURCES, 1975 9

SOFTWOOD SAWTIMBER OUTPUT ALTERNATIVES FROM PRIVATE LANDS IN THE NORTH COAST REGION 10
  Scenario 1 10
  Scenario II 11
  Scenario III 11
  Scenario IV 11
  Scenario V 12
  Scenario VI 13
  Scenario VII 13
  Scenario VIII 14
  Scenario IX 16

IMPACTS OF MAJOR ASSUMPTIONS 16
  Scenario X 17
  Scenario XI 17

OUTPUT OF SAWTIMBER FROM PUBLIC LANDS 18

CONCLUSIONS 19

LITERATURE CITED 20

INTRODUCTION

The timber resources of California's North Coast have made this region an important producer of timber products for California and the Nation's forest products markets for many decades. In recent years, there has been considerable debate about the North Coast's future as a timber producing region. In the mid-1960's, and again in the 1970's, that debate was touched off by proposals first to establish, and now to enlarge the Redwood National Park. The debate has focused mainly on whether the dwindling supplies of large old redwood timber in Del Norte and Humboldt Counties should be converted to products or preserved in Parks. But for those who are concerned with the long-term economic welfare of the region and its people and long-term production of wood products for national markets, the focus must be broadened to consider the outlook for timber of all types in the entire North Coast. This study is intended to contribute to that broader focus.

This study addresses several questions about the future output of timber in the North Coast region of California, which includes Del Norte, Humboldt, Mendocino, and Sonoma Counties. More specifically, it is concerned with the prospects for output of softwood sawtimber from private lands of the North Coast over the next 25 years. The four counties were grouped as a logical regional unit because they have similar natural resources, common markets for their forest products, interconnected economies, and a common transportation system. Softwood sawtimber has been selected for study because it is the raw material that now supports the timber economy, a situation not likely to rapidly change. The emphasis on output from private lands recognizes that, (1) private owners control 75 percent of the commercial forest area, from which comes over 80 percent of the region's timber output, and (2) output from public lands is based upon planned allowable harvests which generally are not subject to rapid change. The 25-year study period was selected to span the transition period from old to young timber stands, yet not to exceed the abilities of available techniques and data to project timber stands.

The outlook for timber output in the North Coast may concern a number of audiences at this time. Among these are Congress, which is considering Park expansion, and the State legislature and local governmental units, which are contemplating the impacts of the new timber yield tax. Local governmental units are also concerned with employment aspects of future timber output. The California Department of Forestry, responsible for administering the Forest Practices Act and providing planting stock for harvested lands, needs information that will help determine the future demands on its organization. Public land management agencies in the region can benefit by an awareness of trends in the private sector which will in part determine demands on public resources. And the forest industries need to know of future timber output prospects, so that they can make informed decisions regarding resource use and investments.

The following questions are addressed in this study:

1. What is the current softwood sawtimber inventory in the North Coast, and what are its characteristics?
2. At what rate is it being harvested?
3. Given continuation of current rates and patterns of harvest, how long can current output levels be maintained?
4. Can a change in patterns of use result in maintenance of current output levels for 25 years?
5. What level of output can be maintained for 25 years or longer?
6. What future level of wood input to the region can be expected from public lands?

This study of necessity treats timber outlook prospects for aggregates of all owners within broad owner classes in the North Coast. The aggregate forest conditions and prospective future outputs are indicative of the overall situation in the region. They are not indicative, however, of the timber resource situation on the forest lands of any individual forest land owner.

PROCEDURES

To meet the objectives identified for this study, it was necessary to undertake a number of steps in preparation for the analysis of future outlooks. Those steps are summarized here and amplified as necessary in the following pages. First, the existing timber inventory data had to be restructured to make it descriptive of discrete stands and to facilitate development of growth predictions and adjustments for harvesting. The second step was to develop growth predictions needed to update the inventory and project it into the future. Then actual harvest since inventory had to be determined. The next step was to update the inventory to provide an estimate of the current resource base. The final step was to investigate the impacts of several alternative future output levels on the resource base in order to determine potential timber output prospects for the region, and for some political, ownership, and resource subunits thereof. Readers not interested in the detailed procedures can save time by turning to the discussion of future output alternatives on page 10.

THE FOREST INVENTORY DATA BASE

The timber inventories of North Coast counties were conducted in the 1960's (Oswald and Walton 1966, Oswald 1968, Oswald 1972). As part of the inventories, timber stand attributes were collected on 629 1-acre field plots. These field plots are the source of basic resource data used in this study.

Before classifying the inventory data into discrete stands for use in this study, the method of stand growth prediction had to be selected. After careful study of the resource data for the Region, the yield table approach was discarded. Due to the condition and complexity of the stands, existing yield tables were descriptive of a very small proportion of the stands. The stand table projection method was selected to project growth and development of the region's timber stands.

The next step was development of stand descriptions broad enough to make the use of stand table projections feasible, yet descriptive of the condition and merchantability of the stands. Species types, stand size, stand density, and site class were selected as key variables for use in defining the timber classes. Since this study is concerned with species and size of merchantable trees, a system of stand (plot) classification was devised that favored softwoods over hardwoods, and basal area-sized trees (5.0-inches + d.b.h.) over seedlings and saplings. This was to insure that the maximum number of acres with merchantable material be identified in the classification process.

Following is a summary of the major criteria used in classifying the plots

1. A stand needs only 10-percent conifer stocking to be a conifer stand, regardless of of hardwood stocking.
2. A stand needs only one-third of stocked area in basal area-sized trees (5.0-inches + d.b.h.) to be classed as poletimber or sawtimber stand.
3. Conifer poletimber and sawtimber stands are placed into five basal area classes, base upon all live conifer trees.
4. Conifer stands are classed as redwood or other conifer, bas on predominance of stocking.
5. Areas are classed as high or low site, based upon potentia to produce wood. Those with mean annual increment potenti of 120 cubic feet per acre/ year or more are high site; if not, low site.
6. Seedling-sapling stands are placed into one of two stocking classes; ≥ 70 percent of area stocked; and < 70 percent of area stocked.

The combination of stand variables yielded 71 potential classes or stand descriptions. Each of the 629 plots from the North Coast inventories was placed in its appropriate class. Many classes contained no plots or too few to provide adequate tree data for prediction of growth and development of other average stand parameters. It was therefore necessary to collapse some classes into others. In most cases, stand sizes were combined; in a few instances site classes were combined. Neither species nor basal area classes were combined in the process. The process of combination yielded 31 stand classes. Table 2 provides a list of these final classes, with brief descriptive features of each.

Stand classes 1 through 22 include 850,000 acres of private forest land classed as having potential for timber production, but whose condition or stage of stand development in 1967 makes it unlikely that they will produce harvestable sawtimber before year 2000. Of this area, 703,000 acres (classes 1 through 6) were either not stocked with trees or were stocked with hardwoods rather than conifers in 1967. Even if some of this area was restocked with conifer seedlings in the last 10 years, it

Table 2--*Summary of timber class descriptions North Coast region, California*

Timber class	Type	Site[1]	Stand size	Stocking level[2]
1	nonstocked	low	--	--
2	nonstocked	high	--	--
3	hardwood	low	seedling-sapling	[3]
4	hardwood	high	seedling-sapling	[3]
5	hardwood	low	poletimber or larger	[3]
6	hardwood	high	poletimber or larger	[3]
13	redwood	high	seedling-sapling	<70%
14	redwood	high	seedling-sapling	≥70%
19	other conifer	low	seedling-sapling	<70%
21	other conifer	high	seedling-sapling	<70%
22	other conifer	high	seedling-sapling	≥70%
43	redwood	high	sm. sawtimber	<50
44	redwood	high	sm. sawtimber	50-100
45	redwood	high	sm. sawtimber	100-200
46	redwood	high	sm. sawtimber	200-300
47	other conifer	low	sm. sawtimber	<50
48	other conifer	low	sm. sawtimber	50-100
55	redwood	low	lg. sawtimber	<50
56	redwood	low	lg. sawtimber	50-100
59	redwood	high	lg. sawtimber	<50
60	redwood	high	lg. sawtimber	50-100
61	redwood	high	lg. sawtimber	100-200
62	redwood	high	lg. sawtimber	200-300
63	other conifer	low	lg. sawtimber	<50
64	other conifer	low	lg. sawtimber	50-100
65	other conifer	low	lg. sawtimber	100-200
67	other conifer	high	lg. sawtimber	<50
68	other conifer	high	lg. sawtimber	50-100
69	other conifer	high	lg. sawtimber	100-200
70	other conifer	high	lg. sawtimber	200+
71	redwood	high	lg. sawtimber	300+

[1] Site class is based upon potential yield, cubic feet per acre mean annual growth, at culmination of increment in fully stocked stands. Low site is 20-119 cubic feet, high site ≥120 cubic feet.

[2] Percent of area stocked with conifers for seedling-sapling stands, square feet basal area of all conifers 5.0 inches + d.b.h. for sawtimber stands.

[3] Stocking levels were not specified for hardwood stands.

could not produce 40-year-old softwood sawtimber until about 2010.

About 115,000 acres (classes 13, 19, 21) were partially stocked with conifer regeneration in 1967. Although over half of this area is low site, some of the higher site lands might produce harvestable sawtimber stands by year 2000, or shortly thereafter.

The 32,000 acres in classes 14 and 22 were high site lands well stocked with regeneration in 1967. Some of this area will likely produce well stocked stands of sawtimber of merchantable size by year 2000 or shortly thereafter.

In this study, no sawtimber yield is assumed for any of this area (850,000 acres), because it is likely that at most only a few thousand acres have the potential to produce usable output before year 2000. Much of this area is unlikely to contribute softwood sawtimber output even beyond the turn of the century, due to current condition and small potential for remedial treatment.

Stand classes 43 through 71 are termed sawtimber classes because they contain timber considered available for harvest immediately or in the near future. These classes are broadly defined and include a number of stand conditions. Included are some areas that could be classed as seedling-sapling stands; but they had sufficient conifer trees of pole or sawtimber size to warrant inclusion as sawtimber stands, on the basis that the merchantable elements of the stand will be of more value in the near term than the regeneration. The sawtimber classes include all of the region's coniferous poletimber stands. Also included are the stands of residual timber and scattered seed trees.

Stand classes 43 through 48 are young stands of small sawtimber (<21-inch d.b.h.) and poletimber. Stand classes 55 through 71 are large sawtimber and include large young sawtimber, old sawtimber, mixed stands of young and old timber, and residual and seed tree stands. The sawtimber stands characterized by low basal area contain most of the region's acreage of seed tree and sparse residual timber stands.

A few points about the stand classes need clarification. The stand class numbers are a discontinuous sequence because they are the surviving classes from the original classification. "Type" and "stand size" in this classification are not comparable to forest type and stand size as defined and displayed in the inventory reports cited earlier. They were developed solely for this study. Stand size and stocking information are either less detailed or not specified for hardwood stands because this study makes no use of those stands, other than identifying them. It is assumed that those stands and the seedling-sapling stands will contribute little, if any, to softwood sawtimber for the period selected for this study.

Table 3 shows the number of field plots, the expanded acres they represent, and the mean per acre stand values of basal area, volume, and net annual growth for the stand classes developed for use in this study. The areas have been adjusted for area losses and increments associated with establishment of the Redwood National Park. The per-acre stand values are weighted mean values developed from the plots[1] that were assigned to each class. The areas, stand descriptions, and average stand parameters describe the North Coast region's commercial forest resource as it existed at the time of the inventories (approximately 1967), except for the acreage adjustment for the Redwood National Park (which was established in 1968).

Several of the nonstocked and seedling sapling classes (1, 13, 14, 22) have very few plots, which is not desirable for developing mean values. The mean values for conifer growth, volume, and basal area for any of the nonstocked, hardwood, or seedling-sapling stands (classes 1-22) have little use. They are shown merely to emphasize the lack of merchantable softwood sawtimber in those types of stands.

---

[1] The mean per acre values are based upon 573 plots in Humboldt, Mendocino, and Sonoma Counties. The 56 Del Norte County plots were not used in developing the mean values due to differences in plot design. They were however placed in stand classes, and are included in stand class acreages.

Table 5--Selected mean stand parameters, by timber class, North Coast Region, California, 1967

Timber class	Number of field plots[1]	Expanded acres[2]	Mean stand values, per acre							
			Basal area[3]		Growing-stock volume		Sawtimber volume	Growing-stock growth		Net sawtimber growth
			Softwoods	Hardwoods	Softwoods	Hardwoods	Softwoods	Softwoods	Hardwoods	Softwoods
			Square feet		---- Cubic feet[4] -----		Board feet[5]	---- Cubic feet[4] -----		Board feet[5]
1	5	28,334	5	3	130	0	343	7	0	15
2	7	43,488	3	1	63	0	285	0	0	0
3	25	126,916	3	20	90	194	378	1	7	9
4	22	117,630	5	24	165	329	788	7	12	24
5	60	258,206	5	80	119	789	517	0	22	0
6	23	128,108	10	98	289	1,643	1,588	5	44	44
13	2	9,611	20	12	236	153	434	23	4	31
14	2	9,875	12	4	303	55	1,310	11	4	51
19	12	60,186	3	51	87	551	482	0	12	0
21	10	45,383	3	27	53	313	184	12	16	7
22	3	22,130	13	0	356	0	1,610	11	0	59
43	11	57,377	34	18	593	199	1,891	37	7	105
44	13	72,608	74	19	1,506	182	5,097	78	12	302
45	20	99,644	148	43	3,489	460	13,325	156	31	684
46	15	67,301	235	28	5,475	199	22,395	220	16	1,051
47	34	162,554	31	52	815	498	2,493	29	18	111
48	16	79,473	75	43	2,053	458	7,480	62	13	275
55	9	43,081	28	45	808	497	3,515	13	28	52
56	18	89,192	71	45	1,878	448	7,991	35	12	144
59	17	95,861	36	21	1,109	254	5,153	28	9	131
60	15	66,309	73	22	1,811	214	7,779	52	16	217
61	29	157,314	144	40	4,180	436	19,485	91	13	403
62	26	117,998	248	37	7,652	342	37,767	104	14	495
63	43	199,481	32	53	844	478	4,344	15	12	86
64	29	109,444	75	83	2,346	885	12,531	43	23	187
65	15	74,308	125	56	3,576	649	16,834	67	19	327
67	20	98,501	28	35	897	329	4,959	17	1	92
68	13	49,714	76	71	2,459	801	13,943	44	25	207
69	18	80,310	142	49	4,302	625	22,603	60	12	386
70	19	76,534	267	34	8,401	399	49,322	104	10	650
71	22	132,888	432	19	13,531	185	69,461	157	6	757
All classes	573	2,779,759								

---

[1] Due to plot design and lack of growth data for Del Norte plots, mean stand values were developed from 573 plots in Mendocino, Humboldt, and Sonoma Counties.

[2] Area estimates include all private commercial forest lands in Humboldt, Del Norte, Mendocino, and Sonoma Counties.

[3] All live trees ≥5.0-inches d.b.h.

[4] Growing-stock trees ≥5.0 inches, to a 4.0-inch top, O.B.

[5] Scribner rule. Trees ≥11.0 inches to a utilized top.

PREDICTIONS OF STAND GROWTH

The inventories of the North Coast counties, as published or as restructured herein, give an impression of the resource at a time in the past. But that resource is changing continuously through the natural processes of growth and mortality and through activities such as timber harvesting. If the North Coast inventories are to be useful in determining alternative future outputs, they must be updated to a current base date; and there must be a mechanism for projecting them into the future. For national and regional studies of timber conditions and supplies, the Forest Service has developed and used a model called TRAS (Timber Resource Analysis System) (Larson and Goforth 1970, 1974). The model, based upon the stand table projection method of growth prediction, has usually been applied by treating large areas as a single problem. This approach has merit for broad regional or national studies where the results are grouped over large areas, where detailed input parameters for smaller areas are lacking, or where there is no need to know how small parts of the total resource are changing with time.

In the North Coast region, there is a need for better understanding of how components of the total resource have changed and are likely to change in the future. The stands vary as to species, timber size, volume concentration, and growth potential. These are important differences to land managers, mill operators, and end product markets. The stand classification presented in the previous section is an attempt to recognize these important differences and to provide the basis for a detailed approach for updating and projecting the region's timber resource.

For this study, the TRAS program was used for updating and projecting each of the stand classes of sawtimber size (classes 43-71). Since the objectives of the study center on softwood sawtimber availability over the next 25 years, no attempt was made to update or project other stand classes (classes 1-22).

For each sawtimber class, inputs for the TRAS model were developed from stand and tree data taken from the plots in that class. The inputs include number of growing stock conifers by 2-inch diameter class, radial growth and tree mortality rates by diameter class, and total volume, growth, and live tree basal area. All inputs were mean values derived from the plots.

An average acre was developed based upon the mean values of all combined plots in each class. For each sawtimber stand class, the average acre was moved ahead to January 1975 to provide an updated statement of the inventory of each stand, and then projected to the year 2020.

Key assumptions used in making the projections were:

(1) Stands with high basal area (all trees) would experience increased mortality and decreased tree radial growth with increases in basal area. Such "growth constraints" were applied to classes 45, 46, 61, 62, 64, 65, 68, 69, 70, and 71.

(2) In stands with high basal area, ingrowth into the 2-inch diameter class would not effectively add to the stand. No ingrowth into the 2-inch diameter class was used in projecting growth and stand development in those classes listed in (1), above.

(3) Total softwood sawtimber volume in each stand was included as sawtimber yield. No deduction was made for logging residue; it was included as yield to approximate the output from noninventory sources (dead and cull trees).

Softwood sawtimber volume (Scribner rule) on a per-acre basis was projected from 1967 to 2020 for each sawtimber class. The yields are shown in table 4 for 1967 and at 5-year intervals from 1975 through year 2000. The projections for years beyond 2000 are not shown because with one exception they were not used in this study and because of the uncertainties of growth predictions of such long duration. The reader is reminded that these growth predictions were develope as a necessary step in this study. They apply only to the unique "average stands from which they were developed, those characterized herein as existing in the North Coast region in 1967.

Table 4--*Softwood sawtimber yield per acre by timber class and year, North Coast region, California*

(Board feet, Scribner rule)

Timber class	Year						
	1967	1975	1980	1985	1990	1995	2000
43	1,891	2,959	4,012	5,502	7,525	10,145	13,393
44	5,097	7,872	10,075	12,724	15,913	19,756	24,378
45	13,325	18,990	22,667	26,357	29,995	33,545	36,985
46	22,395	30,847	36,064	41,143	46,045	50,764	55,317
47	2,493	3,500	4,271	5,164	6,184	7,342	8,647
48	7,480	9,891	11,695	13,750	16,055	18,619	21,458
55	3,515	3,928	4,187	4,502	4,834	5,171	5,535
56	7,991	9,230	10,112	11,095	12,195	13,422	14,782
59	5,153	6,339	7,225	8,196	9,307	10,623	12,244
60	7,779	9,728	11,243	13,050	15,193	17,714	20,647
61	19,485	22,851	25,131	27,477	29,873	32,299	34,721
62	37,767	41,783	44,341	46,919	49,505	52,089	54,666
63	4,344	5,068	5,569	6,123	6,711	7,345	8,023
64	12,531	14,127	15,229	16,400	17,629	18,899	20,195
65	16,834	19,583	21,436	23,364	25,341	27,340	29,337
67	4,959	5,746	6,295	6,924	7,692	8,653	9,851
68	13,943	15,678	16,863	18,124	19,448	20,816	22,206
69	22,603	25,647	27,469	29,252	31,006	32,801	34,553
70	49,322	54,525	57,754	60,940	64,067	67,125	70,111
71	69,461	75,546	79,369	83,493	87,702	91,679	95,777

DEVELOPMENT OF SAWTIMBER HARVEST INFORMATION

In order to update the sawtimber inventories to 1975 (the date selected as a base date), it was necessary to account for the impacts of harvest in addition to those of growth. Generally available information on harvest by county, such as published annually by the State of California (California Division of Forestry 1967-76), are of little use in updating an inventory detailed by individual stands. For this study it was necessary to detail the impact of harvest on the acres represented by each sawtimber stand class.

The approach used was to visit the ounty assessor's office in each of he four counties and, using current erial photos or mapped or otherwise ecorded harvest information, identify on a plot-by-plot basis) those field lots that had been harvested since nventory. Since the process was time onsuming, steps were taken to mini-ize the effort:

(1) No plots were checked in non-stocked, hardwood, or seedling-sapling classes (classes 1-22).

(2) No plots were checked in the sawtimber classes with less than 50 square feet of conifer basal area (classes 43, 47, 55, 59, 63, 67).

(3) In sawtimber classes with 50-100 square feet of conifer basal area (classes 44, 48, 56, 60, 64, 68), only plots with 10,000 board feet or more of softwood sawtimber were checked.

(4) In sawtimber classes with more than 100 square feet of conifer basal area (classes 45, 46, 61, 62, 65, 69, 70, 71), all plots were checked.

In all, 206 privately owned plots, about one third of the region's total, were checked. These plots accounted for over 85 percent of the private sawtimber inventory in 1967. The exclusion of sawtimber plots with less than 10,000 board feet in the 50- to 100-square foot basal area classes, and all plots in the <50 square foot basal area classes was arbitrary. It was done on the assumption that very little of the area with low volume would be cut, and that even those areas cut but overlooked would not significantly contribute to total harvest due to low per acre volumes.

Table 5 presents estimates by class of acres harvested from time of inventory through 1974. These data are needed to update the acreage in each stand class so that an updated inventory can be determined. They also make possible estimation of an average annual harvest for the privately owned forests, and they provide one necessary ingredient for evaluating the future impacts of continuation of current rates and patterns of harvest.

Table 5--*Area of privately owned forest land harvested by timber class, 1967-74, North Coast California*

Timber class	Area
43[1]	--
44	--
45	--
46	4,625
47[1]	--
48	--
55[1]	--
56	--
59[1]	--
60	3,233
61	51,444
62	45,876
63[1]	--
64	16,989
65	45,083
67[1]	--
68	9,280
69	14,896
70	33,922
71	72,325
All classes	297,673

[1] It was assumed that no harvest took place in these classes, due to low basal area and volume.

Before the harvest data were used to update the inventory, they were checked for reasonableness. If we assume (1) an 8-year harvest period with harvest distributed by timber classes as shown in table 5, (2) an average volume per acre derived by summing the 1967 and 1975 volume per acre (table 4) and dividing by 2, and (3) that each acre cut had all of its softwood sawtimber harvested, the average annual harvest from private lands is estimated to be 1,452 millio board feet. For the same period, the California Division of Forestry harvest reports, revised to exclude harvests from public lands and non-inventory sources, indicate an averag annual sawtimber harvest of 1,494 million board feet.

Year	All counties	Humboldt-Del Norte	Mendo Sono
	(MMBF)		
1967	1,554	1,104	45
1968	1,648	1,137	51
1969	1,582	1,096	48
1970	1,343	919	42
1971	1,381	935	44
1972	1,493	1,003	49
1973	1,516	1,022	49
1974	1,433	950	48

The acres harvested since inventor constitute an additional class of timberland which can best be characterized as "acres cut" since inventor This class, totaling 298,000 acres, is an area about which little is known. The ownership and site class are known, for they don't change with harvest. But amount of residual volume (if any), stocking level, and other detailed information can only come from inspection on the ground. For this study they are treated as cutover acres that will not contribut significant sawtimber volume over the next 25 years.[2]

---

[2] In Humboldt and Del Norte Counties, most of the acres cut were "clearcut," or "seed tree" cuts, in which only a few sawtimber conifers were left standing. In Mendocino-Sonoma, there was also much clearcutting and seed tree cutting. On a substan tial area in these two counties, however, selective harvest of conifers has left substantial volumes of residual timber. This residual volume, on areas cut from 1967 to 1974, is "lost" in this study; however, residual volume on acres harvested prior to 1967 is in the study.

But in the longer term, those cutover acres and the acres that will be harvested in the years to come will become vitally important.

THE NORTH COAST REGION'S PRIVATE SAWTIMBER RESOURCES, 1975

The recent years of growth and harvest in the North Coast's privately owned timber stands have substantially altered this resource. Acreage in sawtimber (classes 43-71) declined 15 percent from 1967 to 1975.

Softwood sawtimber inventory decreased about 7 billion board feet or 21 percent, due to sawtimber harvest in excess of growth.[3] Volume increases attributable to growth offset 4.6 of the 11.6 billion board feet of harvest on private lands during the period.

Tables 5 and 6 show some patterns of resource use that will have consequences for future outputs in the North Coast Region. Although 10 of the 20 sawtimber classes have been partially harvested during the 8-year period, the impacts have fallen primarily on five classes (61, 62, 65, 70, 71). Predictably, those classes experiencing heavy use were the high volume/large sawtimber classes. One class in particular has carried a huge share of the harvest. Class 71, the redwood class with the highest per-acre basal area and volume, accounted for 45 percent of the total private harvest; both volume and area in this class have declined over 50 percent.

Twelve of the 20 classes, including 2 that have experienced minor amounts of harvest, show considerable increases in inventory volume, reflecting sawtimber growth in those classes. The remainder of classes have experienced volume decreases due to acres and volume harvested in excess of the growth increases on the acres remaining (uncut) in each of these classes.

Table 6--*Area and volume of privately owned sawtimber stands, by timber class, 1967 and 1975, North Coast region, California*

Timber class	Private			
	1967		1975	
	Area[1]	Volume[2]	Area[1]	Volume[2]
43	57,377	108.5	57,377	169.8
44	72,608	370.1	72,608	571.6
45	99,644	1,327.8	99,644	1,892.2
46	67,301	1,507.2	62,676	1,933.4
47	162,554	405.2	162,554	568.9
48	79,473	594.5	79,473	786.1
55	43,081	151.4	43,081	169.2
56	89,192	712.7	89,192	823.2
59	95,861	494.0	95,861	607.7
60	66,309	515.8	63,076	613.6
61	157,314	3,065.3	105,870	2,419.2
62	117,998	4,456.4	72,122	3,013.5
63	199,481	866.5	199,481	1,011.0
64	109,444	1,371.4	92,455	1,306.1
65	74,308	1,250.9	29,225	572.3
67	98,501	488.5	98,501	566.0
68	49,714	693.2	40,434	633.9
69	80,310	1,815.2	65,414	1,677.7
70	76,534	3,774.8	42,612	2,323.4
71	132,888	9,230.5	60,563	4,575.3
Total	1,929,892	33,199.9	1,632,219	26,234.1

[1] Acres.

[2] Million board feet, Scribner rule.

---

[3] The nonsawtimber stands (classes 1-22), which accounted for less than 2 percent of sawtimber volume and growth in 1967, were not updated and are not included in these data.

It should be noted that the data for this study came from several inventories. These data have been combined and updated. No estimates of precision can be made for these modified data. Those interested in statistical precision of the inventories used in this study should refer to Oswald and Walton 1966; Oswald 1968, and Oswald 1972.

SOFTWOOD SAWTIMBER OUTPUT ALTERNATIVES FROM PRIVATE LANDS IN THE NORTH COAST REGION

What is the outlook for timber output from the private lands that have historically provided most of the region's timber? This question can best be answered by identifying and answering several more specific questions.

SCENARIO 1[4]

The present timber economy is using types and quantities of timber that meet the needs of the existing facilities and the markets for which they produce. Can the region's private softwood sawtimber resource continue to meet these needs by sustaining the current patterns and rates of harvest for some time in the future? Patterns refer here to groups of timber classes, and rates to acres (and volumes) harvested by timber class. The time period selected for analysis, as was mentioned earlier, is 25 years. This question might be termed the recent trends scenario. If the 10 classes that have been providing the harvest are harvested at their historical acreage rates, they will provide outputs over the next 25 years as follows:[5]

	1975	1980	1985	1990	1995	2000
Number of classes harvested	10	9	7	6	5	5
Sawtimber harvest (MMBF)	1,529	1,507	585	342	162	173

Of the total 1975 harvest, 1,410 million board feet (92 percent) comes from five large, high volume classes (61, 62, 65, 70, 71).[6] With current use rates, class 65 will be exhausted in 1979; in 1981, class 71, which has been providing 45 percent of all output from private lands, will be exhausted, followed by class 70 in 1984, and classes 61 and 62 in 1990. The five other classes can produce well into the next century at current acreage depletion rates but will yield less than 200 million board feet per year at those rates.

What can be learned from this scenario? One conclusion easily drawn is that the types of forest stands that have been supporting the region's private harvest will soon be exhausted under current rates of use. A shift in harvest from acres with high volume concentrations in large trees to acres with lower volumes and smaller trees will be required if output of timber from the private sector is to be maintained in the years to come.

The first scenario is unlikely to occur. The timber-based industries have historically responded to declining availability of one timber resource by adjusting to others. In the North Coast region, it is likely that smaller sawtimber in lower volum per acre concentrations will be used increasingly as high volume stands become more scarce. The following discussion will explore some possible alternatives to Scenario 1.

---

[4] To facilitate identification the questions in the following pages will be identified and referred to as numbered scenarios.

[5] The process used to investigate the future prospects for sawtimber output from private lands in the North Coast region is the same one used to update the inventory. The yields (table 4) and the 1975 acres by timber class (table 6) are the basic ingredi The acres harvested by class (table 5) and t annual harvest rates implied (acres harveste per year) are also used. The process is simply a bookkeeping approach, consisting of selecting patterns (by class) and rates of harvest, or patterns and total desired amoun of harvest. The product of acres x volume for all harvested classes provides the estim of total output. All acres are assumed to b clearcut, and the net softwood sawtimber inventory volume on each is assumed to be output.

[6] These classes correspond to the class names shown in the tables presented earlier. Tables 2, 3, and 4 should be consulted if a description of classes is needed.

Two major assumptions were employed in investigating specific questions about the ability of the sawtimber resource to sustain recent harvest levels by departing from recent patterns and rates of harvest. They are: (1) harvest rate. In some instances the historic harvest rates for the (five) heavily harvested classes are used; in other instances a specific period (10 years) is used for depletion. For all other classes, a 10-year depletion schedule is used--that is, one-tenth of the acreage in each class is harvested each year; (2) stand availability. No stands are considered available until they have at least 5,000 board feet of softwood sawtimber. Under this assumption, 17 of 20 sawtimber classes are available in 1975, 19 in 1985, and 20 in 1995. This assumption has essentially no limiting effect on any of the scenarios in which it is used.

SCENARIO II

If the five high use classes are used at their historic harvest rate and other classes are used on the basis of ighest volume classes[7] first, how long an recent output levels be maintained?

	1975	1980	1985	1990	1995	2000
mber ut F)	1,500	1,500	1,481	1,433	532	24
ested	33,965	28,828	71,507	115,064	65,685	4,308

his scenario indicates that, if classes ith high historic use patterns are ugmented by other stands on a high olume first basis in order to maintain utput, harvest can be maintained at ecent levels until 1989. From 1990 to 994, harvest will drop slightly; and y 1995, only low volume sawtimber tands will be available and harvest ill drop to one-third of current evels. Another significant feature f this scenario is that by 1990, a 0-percent increase in harvested creage will be required in order to aintain the output, a reflection of he low per-acre volumes on the acres rospectively available at that time.

SCENARIO III

If the five high use classes are harvested over 10 years instead of at historic rates, and output from them is augmented by other classes on a high volume first basis, the output pattern will be somewhat different.

	1975	1980	1985	1990	1995	2000
Sawtimber output (MMBF)	1,483	1,489	1,481	1,524	141	164
Acres harvested	37,306	34,172	108,484	105,350	20,563	20,563

The primary difference between this and Scenario II occurs in 1990 and 1995, when, due to differences in scheduling of classes, more output is in prospect in Scenario III in 1990, less in 1995. Otherwise the prospects for output are similar to those of Scenario II.

SCENARIO IV

Another approach to harvest scheduling is investigated because theoretically it can maximize the output potential over time. This approach might be termed the "protect growth" scenario. In this scenario the stands with the lowest growth percent are harvested first, thus protecting those stands that have the most efficient (highest) growth percent.[8] Each class is harvested over a 10-year period. In terms of output over time this scenario is almost identical to the previous scenario.

	1975	1980	1985	1990	1995	2000
Sawtimber harvest (MMBF)	1,511	1,498	1,458	1,507	223	278
Acres harvested	50,983	31,035	113,216	93,268	17,307	17,307

The similarity occurs because the historic harvest pattern, the high volume pattern, and the low growth percent pattern order the stands for harvesting in a similar way. In other words, the recent historical cutting pattern tends to maximize the output per acre harvested and defers harvest of those stands that are most efficient in terms of growth percent. From the standpoint of maintaining output of sawtimber, there is little to choose from between the high volume and the low growth percent harvest approaches. They select essentially the same stands in the first decade; and because of heavy demands made upon remaining stands, almost all of the available stands are harvested in the second decade.

---

[7] When harvest priorities were based upon lume, the ordering of stand classes was based pon mean volume, 1975-2000, determined by umming 1975 and 2000 values and dividing by 2.

[8] Growth percent is the ratio of sawtimber growth to sawtimber volume.

All of the scenarios discussed to this point are similar in one important aspect. They all indicate that recent levels of sawtimber output from the North Coast region's important private sector cannot be maintained for more than 15 to 20 years. If they are maintained for that period by rapid harvest of young stands, a large falldown in output must almost certainly follow. There will not be enough sawtimber reserves to support output into the early years of the next century, at which time stands established in recent years will be of merchantable size.

As older stands are harvested, logging operations are moving into younger stands which will eventually provide most of the Region's output. But recent levels of output cannot be maintained by available young sawtimber stocks, and attempts to do so will rapidly deplete the young timber resource and result in precipitous declines in output.

As an alternative to high outputs for 15 to 20 years followed by abrupt falldowns, the Region's forest enterprises could follow a course that would allow higher future outputs. Such a course would involve near-term downward adjustments in sawtimber output, which would allow more sawtimber stocks to be carried for future use. Those stocks could bridge the potential gap between availability of existing sawtimber stands and availability of stands only now being established.

SCENARIO V

There are many potential profiles of harvest that might bridge the gap; one was developed in this study. For this scenario, low growth percent stand classes were harvested first, and stand classes were harvested on 10-year schedule. The goal was to stretch output from the existing private sawtimber resource over a 40 year period, utilizing a rapid transition to a level that could be sustained through year 2015. This was achieved by assuming an immediate 20 percent decrease in output, followed by decreases in 1980 and 1985, with stable output thereafter.

This scenario indicates that with rather substantial declines starting in 1975, output from sawtimber stand in the private sector could be maintained at about 60 percent of recent levels from 1985 to 2015. This type of alternative has its drawbacks and merits. On the negative side, it would require immediate downward adjustment in output from the privat sector, resulting in rather severe impacts on the region's economy. It merits are that it could forestall a even more severe economic impact in 15 to 20 years and provide a timber resource to carry a scaled down forest enterprise into the next century, at which time stands only now being established might become available for harvest.

As some of the other scenarios have indicated, the time for choosing among alternatives is short. Another 10 years (or even less) of outputs at the 1967-74 levels will foreclose on the region's options to stretch out the use of its private sawtimber resources to 2015.

SCENARIO V

	1975	1980	1985	1990	1995	2000	2005	2010
Sawtimber harvest (MMBF)	1,216	1,047	895	877	857	885	875	917
Acres harvested	26,902	17,529	53,196	62,592	35,001	24,179	47,357	45,148

All of the scenarios have in common prospects for declining output of sawtimber in the North Coast region, before the end of this century. But what of the pieces of this complex timber resource puzzle? For all of the scenarios developed and presented, sawtimber resources of different species groups, from different owner groups, in different geographic areas have been treated as interchangeable. In reality, these differences might render some of the timber resources unavailable as substitutes for others. Limitations of the data make it impossible to explore all of the different timber resource characteristics that might bear on output. Three will be explored in the following pages. First, redwood and Douglas-fir stands will be looked at as separate entities. Second, forest industry and miscellaneous private owners will be treated separately. Third, two rather independent subareas of the region, Humboldt-Del Norte and Mendocino-Sonoma will be studied briefly.

A pair of scenarios is developed or each pair of resource characteristics. he harvest priority used in each cenario first treats high volume tands with high-use classes harvested t historic rates, and then other lasses harvested in 10 years. The oal for each scenario is maintenance f harvest at recent levels.

CENARIO VI

The redwood and Douglas-fir (other onifer) stands have different composiions, although each type of stand may ave considerable amounts of the other pecies. The prospects for the stands n either type will give some indication f the output prospects for the namesake ecies. In this scenario output from dwood stands can be maintained at cent levels until 1989; but by 1995 w sawtimber stands will be left and tput will drop below 100 million board et. Given the assumptions of this scenario, Douglas-fir output can be maintained until 1994, when all available stands will have been harvested. The total output arrived at by summing the two types is similar to some of the other scenarios, though not identical because of the different combinations of classes harvested by decade.

	1975	1980	1985	1990	1995	2000
edwood output (MMBF)	1,070	1,134	1,051	741	80	24
ouglas-fir output (MMBF)	509	425	486	553	0	0
Total	1,579	1,559	1,537	1,294	80	24

SCENARIO VII

The two major subgroups of privately owned forest land in the North Coast Region are forest industry and miscellaneous private. The former category includes forest lands owned by companies operating timber processing plants. The latter owner group includes all other privately owned forest land, including land owned by farmers, speculators and recreationists, and lands managed for timber production by those not operating processing plants. A major differentiation between the two subclasses of private ownership is that the latter group has resources uncommitted to processing facilities and therefore potentially available in the raw material markets. Though not much is known about their availability for timber production, these miscellaneous private lands have, and will continue to provide considerable amounts of raw material for the region's forest industries. For this study all of the miscellaneous private timber stands are considered available. This simplifying assumption probably results in overestimation of output potential for this owner group.

In 1975 forest industry lands included 49 percent of the region's privately owned sawtimber stands and 55 percent of the sawtimber volume (table 7). In recent years, this owner group has accounted for over two-thirds of the private sawtimber output. Recent levels of output, however, cannot be maintained beyond

	1975	1980	1985	1990	1995	2000
Forest industry (MMBF)	1,060	1,036	843	337	9	10
Miscellaneous private (MMBF)	504	449	444	486	460	511
Total	1,564	1,485	1,287	823	469	521

Table 7--*Area of privately owned sawtimber stands by timber class and owner, North Coast region, January 1, 1975*

Sawtimber class	All private	Forest industry	Miscellaneous private
	----------(Acres)----------		
43	57,377	27,091	30,286
44	72,608	30,410	42,198
45	99,644	65,347	34,297
46	62,676	38,865	23,811
47	162,554	45,251	117,303
48	79,473	21,433	58,040
55	43,081	17,679	25,402
56	89,192	55,939	33,253
59	95,861	72,236	23,625
60	63,076	44,236	18,840
61	105,870	65,826	40,044
62	72,122	51,354	20,768
63	199,481	65,066	134,415
64	92,455	37,479	54,976
65	29,225	9,855	19,370
67	98,501	56,618	41,883
68	40,434	15,506	24,928
69	65,414	24,186	41,228
70	42,612	14,055	28,557
71	60,563	41,106	19,457
Total	1,632,219	799,538	832,681

1984;, and by the early 1990's few sawtimber stands, and little sawtimber output will be available if recent levels of harvest continue into the mid-1980's.

The miscellaneous private lands have adequate sawtimber stands to maintain recent sawtimber output levels until 2000. Given the likelihood of decreasing output from industry lands, the sawtimber resources of these small private ownerships could be of increasing importance to the region's timber economy during the next 25 years, if they are made available for harvest by their owners.[9]

SCENARIO VIII

The geographic separation of the region into two areas is potentially the most meaningful of the pairs of scenarios investigated. Humboldt-Del Norte and Mendocino-Sonoma are at different stages of development in their use of timber resources. The latter counties experienced drastic falldowns in output 15 to 20 years ag in what was likely a major adjustment to declining sawtimber reserves. In Humboldt-Del Norte, private output ha dropped somewhat since the late 1960' but stabilized in the early 1970's. No major downward adjustment is yet i evidence.[10] These two counties are still largely dependent on the decreasing acres of large sawtimber stands.

	1975	1980	1985	1990	1995	2
Humboldt-Del Norte (MMBF)	1,039	826	896	71	66	
Mendocino-Sonoma (MMBF)	519	555	583	529	549	5
Total	1,558	1,381	1,479	600	615	5

---

[9] Some forest industrial landowners in the North Coast have an active program directed toward expansion of their forest land and timber base through acquisition of miscellaneous private holdings. Consequently, some of the lands considered "miscellaneous private" or "small private" in this study are probably now owned by forest industrial companies.

[10] The mean private output 1965-69 was 1,246 million board feet; in 1970-75 it was 1,052 million board feet, 84 percent of the late 1960's average, and 94 percent of the average output (1,122 million board feet) for the 1967-74 period.

In 1975, Mendocino-Sonoma had 54 percent of the privately owned sawtimber acreage in the North Coast region, and 53 percent of the sawtimber inventory (table 8). Recent levels of output can be maintained to 2010 or beyond from existing sawtimber stands. In contrast, 82 percent of Humboldt-Del Norte output is being supported by three high-use timber classes that will be gone (at recent rates of use) by 1980. Although these two counties have less than half of the region's privately owned sawtimber volume, they have been producing over two-thirds of the private timber output. Given the assumptions of this scenario, private output in Humboldt-Del Norte will fall 20 percent by 1980; and by 1990, there will be few if any sawtimber stands and little sawtimber volume available for harvest.

This last pair of scenarios is perhaps the most important of all the ones developed for this study. They indicate that the most important timber-producing county in California, Humboldt, and its adjoining neighbor to the north, Del Norte, are on the verge of a major downward adjustment in sawtimber output from the private lands that have provided those counties' timber outputs for 125 years. Mendocino-Sonoma's output is supportable from existing sawtimber inventories. It appears as though Humboldt and Del Norte Counties will very soon be confronted with the economic consequences of substantial dislocations in their major basic industries. The sawtimber outlook in those two counties is responsible for the decline in sawtimber output indicated in the earlier scenarios for the entire region.

Accelerated harvest of Mendocino-Sonoma's sawtimber stands, including young stands, could provide raw material to temporarily postpone regional output declines and provide raw material for some of Humboldt-Del Norte's mills. But such raw material substitution, if it occurs, will merely postpone the eventual declines in regional output, which could then affect Mendocino-Sonoma as well as Humboldt-Del Norte. Scenarios II, III, and IV reflect the regional outcome that could be expected in such a case.

Table 8--*Area of privately owned sawtimber stands, by timber class and county group, North Coast region, January 1, 1975*

Sawtimber class	All counties	Humboldt-Del Norte	Mendocino-Sonoma
	(Acres)		
43	57,377	29,182	28,195
44	72,608	27,521	45,087
45	99,644	58,031	41,613
46	62,676	25,118	37,558
47	162,554	78,726	83,828
48	79,473	37,780	41,693
55	43,081	15,843	27,238
56	89,192	8,996	80,196
59	95,861	53,728	42,133
60	63,076	16,573	46,503
61	105,870	45,986	59,884
62	72,122	18,060	54,062
63	199,481	95,725	103,756
64	92,455	36,404	56,051
65	29,225	10,765	18,460
67	98,501	74,711	23,790
68	40,434	26,725	13,709
69	65,414	35,515	29,899
70	42,612	19,750	22,862
71	60,563	40,385	20,178
Total	1,632,219	755,524	876,695

SCENARIO IX

Are there alternative output levels for Humboldt-Del Norte that evidence less precipitous declines? The answer, of course, is that there are many potential harvest profiles for the area. One alternative is developed here merely to give an idea of the types of reasonable alternatives that are possible within the context of available sawtimber resources. For this alternative, high-use classes are harvested first, followed by other classes in order of decreasing volume. Each stand is harvested over a 10-year period. The objective in this scenario is a gradual decline in output, to stretch the output from existing stands through year 2000. The Mendocino-Sonoma output is unchanged from the previous scenario.

	1975	1980	1985	1990	1995	2000
Humboldt-Del Norte (MMBF)	892	653	503	406	385	401
Mendocino-Sonoma (MMBF)	519	555	583	529	549	527
Total	1,411	1,208	1,086	935	934	928

In this scenario, output in the 1975-79 period is about 15 percent below recent levels of private output in Humboldt-Del Norte. The decline continues until 1990 and then stabilizes at 400 million board feet, about 40 percent of recent output levels. This scenario, when combined with stable output for Mendocino-Sonoma, results in a declining regional output trend that levels out in 1990 at 60 percent of recent output levels. With this scenario, new stands would be needed in 2005 to maintain the harvest beyond that time.

Most of the scenarios developed indicate declining output and uncertain future for the timber economy of the North Coast region. Part of the uncertainty is due to the term of the study, which is 25 years. The future beyond 25 years, though uncertain in the eyes of this study, need not be considered uncertain in a negative sense. Quite a bit is known or can be inferred about the 25-year future of the region's output because the basic ingredient, its existing sawtimber an poletimber stands and their characteristics, are known. But beyond the period of their availability little i known.

In 1967, the region had 850,000 acres of private timberland either unstocked, stocked with hardwoods, or with conifer seedlings. The 298,000 acres of private lands harvested sinc 1967 have stand or stocking condition unknown at this time. Combined, thes areas total 1,148,000 acres or 41 per cent of the privately owned commercia timberlands. Little is known of the current condition of many of these lands. But the effectiveness of man' management and perhaps nature's contr bution on many of these lands and on the hundreds of thousands of acres that will be harvested in the next tw decades will determine the longer ter condition of the forest enterprise i the North Coast region.

IMPACTS OF MAJOR ASSUMPTIONS

This study of necessity has included many assumptions, some of whic might have a significant impact on th projected outputs. The assumptions that can be expected to have impact projected timber output are generall of two types; those that affect amou of yield on a per-acre basis and tho that affect the timing of yield (the availability of stands for harvest).

The yield predictions are based upon an initial condition for each stand or timber class, assumptions about how each stand will grow and develop, and an additional assumptio about extent of utilization when harvested. The predicted yields (table 4) were based upon stand condition and growth data from comprehensive inventories of the region's forests. Since projected output is directly related to per-acre yields, changes in the yields would lead to directly proportional changes in projected outputs.

The assumption that all acres cut from 1967 to 1974 had all of their volume removed has an unknown impact on future sawtimber supplies because the amount of sawtimber residuals or some of these lands that were not clearcut is unknown. The majority of plots that were cut, however, were either clearcut or had only seed trees remaining. If an average of 15,000 board feet were left on one-third (100,000 acres) of the area harvested, an additional year of harvest at recent levels--1.5 billion board feet--would be available.

The use of the clearcut assumption for the projected harvests likely has little different effect than if substantial partial harvests were assumed. vailable evidence on the West Coast indicates that such harvests in mature stands do not increase total yields; t merely spreads them over a period f time (Chambers 1977, Reukema 1972, eukema and Pienaar 1973). Consequently, simulations of partial harvests f more acres with final harvests at a ater date will result in similar utput projections to those achieved ssuming clearcuts on fewer acres.

CENARIO X

The use of a 10-year period for iquidation of each sawtimber class ight conceivably have some impact on he amount of output potentially vailable, although the use of many lasses would seem to minimize the mpact of this assumption. As a imited test, a scenario was developed n which first the five high-use lasses, then the rest of the classes high volume first) were harvested, ach in 5 years. The impact of the -year harvest assumption can be etermined by comparing this scenario ith Scenario III. The outputs by -year period are very similar to cenario III until 1995, but then the -year rule allows more flexibility, d available sawtimber classes are sed at a more rapid rate. Other ules" regarding duration of harvest class would also have some impact the sequence of acres harvested.

	1975	1980	1985	1990	1995	2000
imber (BF)	1,494	1,488	1,512	1,494	399	0
harvested	26,478	44,373	63,348	139,638	52,602	0

But the magnitude of total outputs probably wouldn't differ considerably from those presented here.

SCENARIO XI

An earlier draft version of this study had a major assumption that sawtimber stands would not be available for harvest until they had a minimum of 10,000 board feet. Many reviewers expressed the opinion that this was unrealistic, because it excluded over 500,000 acres of residual and seed tree sawtimber that would be harvested in the near future. Consequently, the scenarios have been revised to reflect a 5,000-board foot minimum, which results in availability of all poletimber and sawtimber stands, including the light residual stands and those with scattered seed trees, during the projection period. For comparison purposes, the following scenario uses the 10,000-board foot mimimum for availability. This scenario harvests the five high-use classes first, then other classes on a high volume first basis; each class is harvested over 10 years. Except for the minimum volume per acre standard (10,000 board feet versus 5,000 board feet) this scenario is identical to Scenario III. Comparison with Scenario III indicates that total yield over the projection period is about 2.9 billion board feet less with the 10,000-board foot minimum cutting restriction.

	1975	1980	1985	1990	1995	2000
Sawtimber output (MMBF)	1,483	1,489	1,190	1,193	160	194
Acres harvested	37,306	34,173	63,362	60,228	15,324	15,324

The 5,000 board foot minimum assumption, basic to all study scenarios except Scenario XI, results in "harvest" of essentially the entire private inventory of softwood sawtimber and poletimber over the next 30 years. Given the ownership and condition of many of those lands, it might be deemed unlikely that the timber on all of them will be economically available. In this respect, the basic assumption on availability is very optimistic.

The impacts of many other assumptions will not be pursued here, for it doesn't seem likely that they would have a significant impact on the outcome of this study. In the final analysis, the extent of the region's sawtimber resource and its rate of use are the major determinants of the study's outcome, and they were measured or observed, not assumed.

OUTPUT OF SAWTIMBER FROM PUBLIC LANDS

Although the North Coast region's timber economy is dominated by output from the private sector, the prospects outlined in the scenarios can be better evaluated in terms of their potential impacts if the reader is informed about probable outputs from public lands. The National Forests in and adjoining the North Coast region have and will continue to produce softwood sawtimber available for processing by the region's forest industries. The patterns of timber flows will likely be sustained, due to the location of those resources with respect to location of processing centers. The amounts, however, are subject to fluctuation from year to year. In 1972, timber originating on four National Forests was processed in the region's mills (Howard 1974).

	National Forest of Origin			
	Klamath	Mendocino	Shasta-Trinity	Six Rivers
Timber processed in region (MMBF)	34	27	38	161
Percent of Forest total processed in region	15	35	10	87

Of these Forests, only the Six Rivers and the Mendocino have significant area within the boundaries of the region. It is probable that most of the Six Rivers' harvest and a substantial proportion of the Mendocino's harvest will continue to be processed in the North Coast region. Significant amounts of timber from the western portions of the Klamath and Shasta-Trinity National Forests will likely continue to move to processing facilities in the eastern part of Humboldt County. These are the same facilities that process much of the Six Rivers harvest.

The 260 million board feet that in 1972 flowed from National Forests to the region's processing facilities is perhaps the best estimate of what can be expected in the future. Two key characteristics of this source of raw material are: (1) it is predominate Douglas-fir, and (2) National Forest timber has traditionally gone to nearby plants that are largely dependent on National Forest timber. This timber has not moved to the major industrial processing centers to the west of the Forests that are now dependent on private timber. Decline in private timber output could, however, cause changes in the historic flow patterns of National Forest timber in the region.

Other public lands, wholly within the region, have contributed a signi cant amount of timber to the total harvest. This output has come primarily from the Jackson State Forest in Mendocino County, the Hoopa Valley Indian Reservation in Humboldt County and lands managed by the Bureau of Land Management (BLM). The investiga tion of acres harvested since inventor indicated that from 1967 to 1974, these public lands produced an averag of 115 million board feet per year. In 1972, these "other public" lands produced 98 million board feet of timber for processing. In recent years, however, the allowable harvest on State, Indian trust, and BLM land in the Region have been reduced. The combined allowable harvests for these "other public" lands is now 71 millio board feet, down from 102 million board feet. This new allowable harvest can be sustained from current stocks of sawtimber well into the nex century, and is probably the best estimate available of future outputs from these lands.

For all public lands within and adjoining the region, a reasonable approximation of future output is about 330 million board feet. The output from "other public" lands wou likely increase, because the reserve of growing stock have been used in recent years. National Forest outpu is the subject of much debate; that debate centers around the merits of even flow vs. accelerated liquidatio of old timber with more rapid replac ment by young stands. But changes i allowable harvests have usually een gradual. And even radical changes in output resulting from major changes in law and policy would likely have nly a nominal effect on total raw aterial output. For instance, a 50-percent increase in output from National orests, if captured by the region's ills, would increase the flow of imber into the mills by 130 million oard feet, only 7 percent of recent awtimber output levels for the region. t appears that output from public ands will not offset the prospective eclines in private sawtimber output n the region.

If it is assumed that public lands ill provide a constant output of 330 illion board feet of sawtimber, the ange of total regional outputs for everal scenarios is as follows:

	Public and private output (million board feet)					
	1975	1980	1985	1990	1995	2000
enario I	1,859	1,837	915	672	492	503
enario II	1,830	1,830	1,811	1,763	862	354
enario III	1,813	1,819	1,811	1,854	471	494
enario V	1,546	1,377	1,225	1,207	1,187	1,215
enario VIII combined)	1,888	1,711	1,809	930	945	866
enario IX combined)	1,741	1,538	1,416	1,265	1,264	1,258

CONCLUSIONS

Do all of the scenarios, or any of hem, tell us what is going to happen o softwood sawtimber output from rivate lands in the North Coast region? robably not. Many key and perhaps rtificial assumptions have been made r each scenario. What can be drawn rom the scenarios is a range of otential outcomes which may prove formative to those who have an terest in the region and its timber onomy.

Perhaps of more value than the ecific outcomes of any of the scenarios e the following generalizations that ght be drawn from the study:

(1) Output of softwood sawtimber from the North Coast region's private timber lands will likely decline substantially in the next 10 to 15 years.

(2) The major portion of the decline in private timber output will be centered in Humboldt-Del Norte Counties.

(3) No reordering of cutting priorities among different types of stands will have a significant impact on the prospective falldown in output.

(4) Output will decline in both Douglas-fir and redwood stands.

(5) There are not sufficient sawtimber stocks with associated growth to maintain output until new stands, regenerated since the mid-1950's, can reach merchantable sawtimber size.

(6) Forest industry timberlands, which account for two-thirds of the region's private timber output, will evidence decreases in output within 10 years. Output from miscellaneous private timberlands can be maintained throughout the study period, if all of these lands are available for timber production.

(7) Output of sawtimber from public lands within and adjoining the region is not likely to offset declines in the private sector, but will become more inportant as total sawtimber output declines.

In the near term, little can be done to change the total amount of sawtimber that will be physically available for harvest. There are many possibilities as to how it might be harvested over time. But in the final analysis demand in the product markets will probably be the major determinant. In the longer term, however, virtually every acre of unreserved commercial forest land is a potential producer of sawtimber or other roundwood products. This study has not addressed the potential for that more distant future. But further efforts to study the region's timber resource prospects will likely prove most fruitful if they are so directed.

In the next few years many choices will be made regarding development and management of the region's forests; those decisions will have an impact on the new forests that will be developing. New inventories of forest resources are needed to provide an updated picture. These new inventories should take stock of current timber resources, as did the previous inventories. But they should also be designed to identify the condition of the region's forest lands with respect to the formation of future forests. They should provide the information needed to identify opportunities for management as well as problems, if they are to provide the basis for sound decisions that will result in the North Coast region's future forests.

LITERATURE CITED

California Division of Forestry.
1967-76. Production of California Timber Operators. State Forest Notes (annu. publ.) Sacramento, Calif.

Chambers, Charles J.
1977. A second look at thinning: The effect of thinning on allowable cut. The State position. Washington Dep. of Natur. Resour., DNR Note No. 17, 6 p. January 1977. Olympia.

Howard, James O.
1974. California forest industry wood consumption and characteristics, 1972. USDA For. Serv. Resour. Bull. PNW-52, 91 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Larson, Robert W., and Marcus H. Goforth.
1970. TRAS, a computer program for the projection of timber volume. U.S. Dep. Agric. Agric. Handb. No. 372, 24 p.

Larson, Robert W., and Marcus H. Goforth.
1974. TRAS, a timber volume projection model. U.S. Dep. Agric. Tech. Bull. No. 1508, 15 p.

Oswald, Daniel D.
1968. The timber resources of Humboldt County, California. USDA For. Serv. Resour. Bull. PNW-26, 42 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Oswald, Daniel D.
1972. Timber resources of Mendocino and Sonoma Counties, California. USDA For. Serv. Resour. Bull. PNW-40, 76 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Oswald, Daniel D., and Gerald S. Walt
1966. Forest Statistics for Del Nor
County, California, 1965. USDA For
Serv. Resour. Bull. PSW-5, 12 p. Pa
Southwest For. and Range Exp. Stn.,
Berkeley, Calif.

Reukema, Donald L.
1972. Twenty-one year development of Douglas-fir stands repeatedly thinned at varying intervals. USD
For. Serv. Res. Pap. PNW-141, 23 p
Pac. Northwest For. and Range Exp.
Stn., Portland, Oreg.

Reukema, Donald L., and Leon V. Pien
1973. Yields with and without repe
commercial thinnings in a high-sit
quality Douglas-fir stand. USDA F
Serv. Res. Pap. PNW-155, 15 p., il
Pac. Nothwest For. and Range Exp.
Portland, Oreg.

Oswald, Daniel D.
1978. Prospects for sawtimber output in California's North Coast, 1975-2000. USDA For. Serv. Resour. Bull. PNW-74, 20 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report summarizes a study of sawtimber output alternatives for California's North Coast. Eleven "scenarios" of softwood sawtimber output from private lands are presented. The scenarios differ as to assumptions about rates and patterns of harvest and objectives pertaining to levels of output. Prospects for output from public lands are also discussed.

KEYWORDS: Forest product output, supply/demand (forest products), resources (forest), timber resources, California (north coast).

Oswald, Daniel D.
1978. Prospects for sawtimber output in California's North Coast, 1975-2000. USDA For. Serv. Resour. Bull. PNW-74, 20 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report summarizes a study of sawtimber output alternatives for California's North Coast. Eleven "scenarios" of softwood sawtimber output from private lands are presented. The scenarios differ as to assumptions about rates and patterns of harvest and objectives pertaining to levels of output. Prospects for output from public lands are also discussed.

KEYWORDS: Forest product output, supply/demand (forest products), resources (forest), timber resources, California (north coast).

Oswald, Daniel D.
1978. Prospects for sawtimber output in California's North Coast, 1975-2000. USDA For. Serv. Resour. Bull. PNW-74, 20 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report summarizes a study of sawtimber output alternatives for California's North Coast. Eleven "scenarios" of softwood sawtimber output from private lands are presented. The scenarios differ as to assumptions about rates and patterns of harvest and objectives pertaining to levels of output. Prospects for output from public lands are also discussed.

KEYWORDS: Forest product output, supply/demand (forest products), resources (forest), timber resources, California (north coast).

Oswald, Daniel D.
1978. Prospects for sawtimber output in California's North Coast, 1975-2000. USDA For. Serv. Resour. Bull. PNW-74, 20 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report summarizes a study of sawtimber output alternatives for California's North Coast. Eleven "scenarios" of softwood sawtimber output from private lands are presented. The scenarios differ as to assumptions about rates and patterns of harvest and objectives pertaining to levels of output. Prospects for output from public lands are also discussed.

KEYWORDS: Forest product output, supply/demand (forest products), resources (forest), timber resources, California (north coast).

The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Developing and evaluating alternative methods and levels of resource management.
3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research are made available promptly. Project headquarters are at:

Fairbanks, Alaska
Juneau, Alaska
Bend, Oregon
Corvallis, Oregon
La Grande, Oregon
Portland, Oregon
Olympia, Washington
Seattle, Washington
Wenatchee, Washington

Mailing address: Pacific Northwest Forest and Range
Experiment Station
P.O. Box 3141
Portland, Oregon 97208

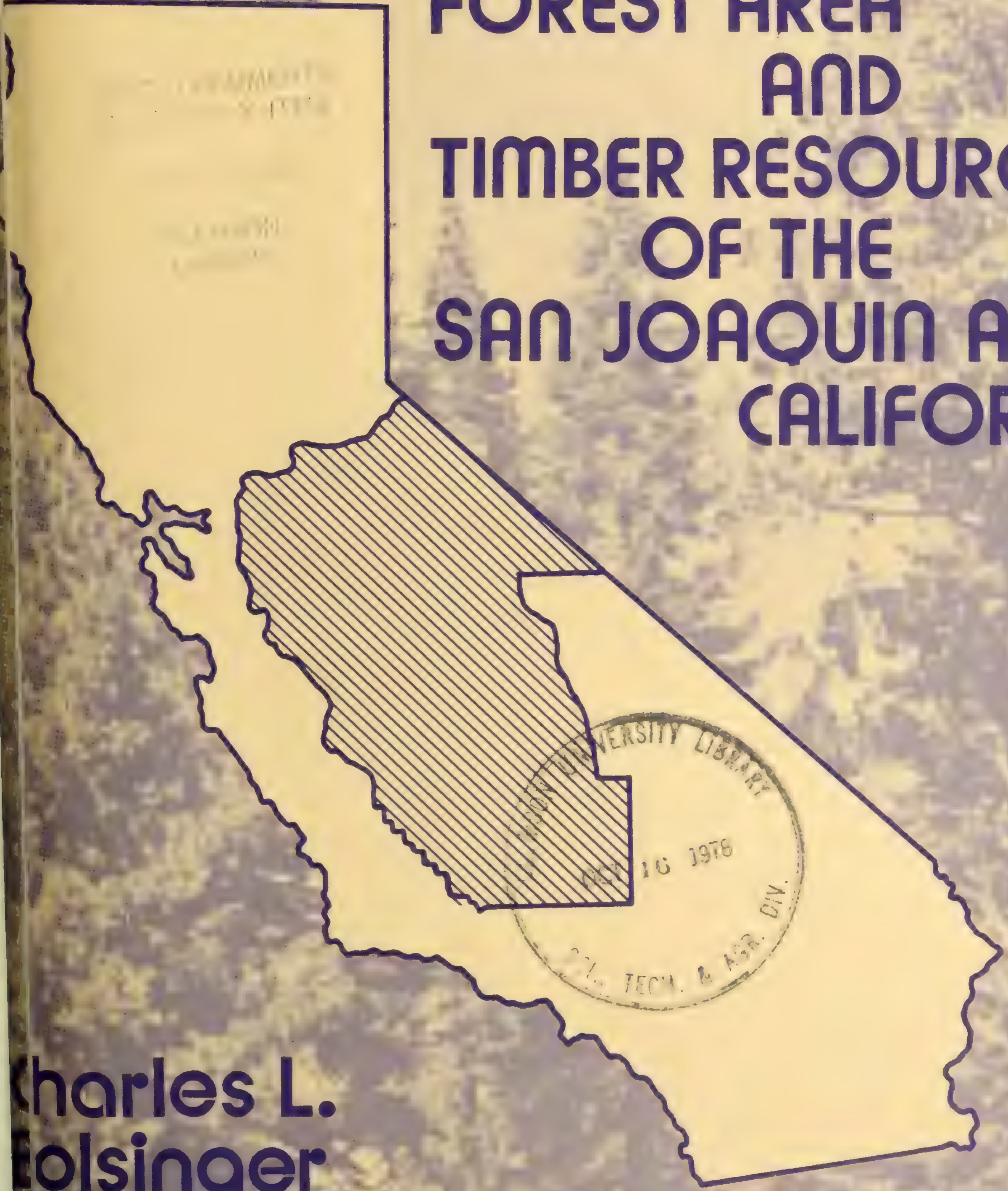
The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

The U.S. Department of Agriculture is an Equal Opportunity Employer. Applicants for all Department programs will be given equal consideration without regard to race, color, sex or national origin.

13.80: PNW-75

1978
USDA FOREST SERVICE RESOURCE BULLETIN PNW-75

FOREST AREA AND TIMBER RESOURCES OF THE SAN JOAQUIN AREA, CALIFORNIA



UNIVERSITY LIBRARY
OCT 16 1978
TECH. & AGR. DIV.

harles L.
olsinger

IFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
DEPARTMENT OF AGRICULTURE FOREST SERVICE
PORTLAND, OREGON

RENEWABLE RESOURCES EVALUATION WORK UNIT

Charles Van Sickle, Project Leader
Donald R. Gedney, Principal Resource Analyst
John M. Berger, Compilation Supervisor
Charles L. Bolsinger, Field Supervisor

ACKNOWLEDGMENTS

Regions 4 and 5 of the U.S. Forest Service supplied resource data and other information for National Forests. The California Department of Forestry, and the Bureau of Land Management and the Bureau of Indian Affairs, U.S. Department of the Interior, provided information on the management of lands under their jurisdiction. Private landowners provided maps and information on access to forest lands, and information related to forest management practices.

METRIC EQUIVALENTS

1,000 acres = 404.69 hectares
1,000 cubic feet = 28.3 cubic meters
1 cubic foot per acre = 0.0700 cubic meter per hectare
1 square foot basal area per acre = 0.2296 square meter per hectare
1 foot = 30.48 centimeters
1 inch = 2.540 centimeters

FOREST AREA AND TIMBER RESOURCES OF THE SAN JOAQUIN RESOURCE AREA, CALIFORNIA

Reference Abstract

Bolsinger, Charles L.
1978. Forest area and timber resources of the San Joaquin resource area, California. USDA For. Serv. Resour. Bull. PNW-75, 71 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report presents statistics on forest area and timber volume and a description of the recent and future timber situations in Alpine, Amador, Calaveras, Fresno, Kern, Kings, Madera, Mariposa, Merced, Mono, San Joaquin, Stanislaus, Tulare, and Tuolumne Counties, California.

KEYWORDS: Forest surveys, statistics (forest), timber resources, resources (forest), California (central).

RESEARCH SUMMARY

Resource Bulletin PNW-75

1978

The San Joaquin resource area, consisting of 14 counties in central California, contains over 7 million acres of forest land--of which 2.2 million acres are classified as commercial forest. Productive forest reserved in parks and wilderness amounts to about 0.7 million acres and unproductive forest, largely foothill oak and chaparral, amounts to about 4.0 million acres. National Forests contain 77 percent of the commercial forest land. National Parks contain 91 percent of the productive reserved forest land. Unproductive forest land is divided almost equally between private owners and public agencies.

Between 1953 and 1973 about 31,000 acres of commercial forest, mostly in private ownership, were converted to pasture, residential developments, reservoirs, and other permanent clearings; 18,000 acres of commercial forest were set aside in National Forest Wilderness and another 17,000 acres were set aside to be studied for possible Wilderness designation. About 117,000 acres of private forest land were reclassified from commercial to unproductive by current methods of determining forest stockability and site potential.

Most of the reclassified area was in the lower western foothills of the Sierra Nevada and in the forest-desert fringe in Alpine and Mono Counties.

Unproductive forest area was reduced by about 265,000 acres between 1953 and 1973, largely by conversion to rangeland and development of water resources.

Potential productivity of the commercial forest land is extremely variable, ranging from sites capable of growing more than 165 cubic feet of wood per acre per year to sites that can barely grow 20. About 41 percent of the commercial forest land can grow at least 85 cubic feet, including 37 percent of National Forests, 39 percent of other public lands, 84 percent of forest industry lands, and 42 percent of other private lands.

Commercial forest lands outside National Forests were classified into manageability categories based on steepness, stockability, and site index. Flat to gently sloping timberlands without stockability problems make up 63 percent of the total, including 47 percent in high sites (85 cubic feet plus) and 16 percent in low sites. Timberlands that are steep and/or have stockability problems make up 37 percent.

The stocking condition of commercial forest land is generally good--only 2.7 percent of National Forests and 4.0 percent of lands outside National Forests are nonstocked with desirable conifer trees. None of the forest industry land was nonstocked at the time of the inventory. On private lands, however, high mortality occurs in white fir and a large area is occupied by low-volume, low-value incense-cedar and hardwood trees. The mortality in white fir is seen as temporary and minor, but the incense-cedar-hardwood situation may limit forest productivity for years to come.

Total volume in growing stock and sawtimber is 8.3 billion cubic feet and 47.4 billion board feet (Scribner rule). Over 95 percent of the volume is in softwoods. National Forests contain 86 percent of the softwood and 78 percent of the hardwood sawtimber volume. Since 1953 the softwood inventory has declined about 12 percent on National Forests and 33 percent on private lands. Fires, pests, conversions, and withdrawals have also reduced the available inventory, but by a small amount.

Net annual growth of growing stock totals 72.3 million cubic feet on National Forests or an average of 42 cubic feet per acre per year. Forests outside National Forests are growing 29 million cubic feet per year, an average of 56 cubic feet per acre per year.

Mortality averages 13 cubic feet per acre per year on National Forests and 12 cubic feet on all other lands. Forest industry lands have the highest mortality, mostly in white fir. Weather, insects, disease, and logging damage were the primary causes of mortality at the time of the inventory.

Timber harvest in the area has remained fairly constant at 400 million to 600 million board feet for over 25 years. The cut in recent years is roughly 12 percent of California's total. The timber provides jobs for about 9,000 people in the area's forests and mills. This is about 2 percent of total employment in the 14 counties and 11 percent of manufacturing employment. Forest industries provide a significant portion of total employment in certain mountain communities.

National Forests contributed an increasing proportion of the cut from 1953 to 1972 while cut on private lands decreased. Since 1972, however, National Forest cut has declined somewhat because of shortage of funds and personnel and delays in timber sale administration due to land use planning and litigation. Further decline in the cut may result from Wilderness classification of some or all of the 137,000 acres of productive forest in roadless areas. These areas contain about 3 billion board feet and have an estimated potential yield of 39 million board feet, roughly 8 percent of the total for National Forests in the area.

The long-term productivity of National Forests appears about equal to the current harvest from all components of commercial forest land. More information on land capability, management techniques and response, interactions of resources, and demand for various forest outputs is needed before the ultimate timber productivity can be determined.

Farmer and miscellaneous privately owned lands are producing considerably less than their potential, and their owners are harvesting only a third of their annual growth. Nonforest developments on farmer and miscellaneous private ownerships were underway on 40,000 acres of land still forested when fieldwork was done. The estimated growth loss by these conversions will amount to 9 percent of the total annual growth on all private lands in the San Joaquin resource area.

Forest industry lands have been yielding timber for several decades. Their cut is slightly less than growth, and it appears they could continue to produce timber at the current level indefinitely. Even these lands, however, are producing somewhat less than their potential.

There seems little incentive for private landowners in the San Joaquin area to make forestry investments to increase timber production. Growing pressure to develop land for nontimber purposes suggests, however, that intensified forest management on lands dedicated to timber production is needed to prevent a future timber shortage.

PREFACE

This report summarizes the results of the 1972 inventory of forest land area and timber resources outside National Forests in 14 counties in California. The counties are Alpine, Amador, Calaveras, Fresno, Kern, Kings, Madera, Mariposa, Merced, Mono, San Joaquin, Stanislaus, Tulare, and Tuolumne. Also included in this report are estimates of total area of commercial and productive reserved forest land and timber volume for National Forest lands in the 14 counties. Current forest resource details comparable to those for other lands are not available for all National Forest lands within the area.

Previous Forest Service reports on California's timber resources have been published, but only one contained specific information for the counties in the San Joaquin resource area--USDA Forest Survey Release No. 25, "Forest Statistics for California" (USDA Forest Service 1954). County details in Release No. 25 included only commercial forest area by public and private ownership and total noncommercial forest area.

The objectives of the 1972 inventory were to estimate the total area of forest land and timber volume, growth, and mortality, by ownership and to determine other facts about forests for the use of planners, policymakers, resource managers and users, and others interested in natural resources.

CONTENTS

Page

THE SETTING 1

THE IMPORTANCE OF FORESTS IN THE SAN JOAQUIN RESOURCE AREA. 4

FORESTS AREA AND OWNERSHIP 5
  Current Forest Area 5
  Productive Reserved and Deferred Forest Land. 6
  Unproductive Forest Land. 7
  Commercial Forest Land. 11

TIMBER-PRODUCING CONDITION OF THE COMMERCIAL FOREST LAND. 17
  Forest Land Productivity. 17
  Stocking Condition. 20
  Stand Size and Age. 23

TIMBER VOLUME 24

GROWTH AND MORTALITY. 26
  Growth 26
  Mortality 26

TIMBER HARVEST AND CONSUMPTION AND INDUSTRIAL EMPLOYMENT. 29
  Timber Harvest. 29
  Log Consumption 29
  Employment in Forest Industries 30

FUTURE TIMBER SUPPLIES. 32

REFERENCES. 58

APPENDIX. 63
  Reliability of Forest Resource Estimates. 63
  Inventory Procedures. 63
  Definition of Terms 65

TABLES

1. Area of commercial forest land by cubic-foot site class and ownership, San Joaquin resource area, California, January 1, 1973 18
2. Area of commercial forest land outside National Forests by growing-stock conifer stocking class, cubic-foot site class, and ownership, San Joaquin resource area, January 1, 1973 20
3. Area of commercial forest land by stand size class in National Forests in the San Joaquin resource area, 1973 24
4. Timber consumption by species, San Joaquin resource area, 1946, 1956, 1962, 1968, and 1972. 30
5. Potential yield and net annual growth by National Forest and commercial forest land component, San Joaquin resource area, California 32
6. Area by land class for all National Forests and for all lands outside National Forest by county, San Joaquin resource area, California, January 1, 1973. . 35
7. Area of commercial forest land by ownership, San Joaquin resource area, California, January 1, 1973. . 36
8. Area of commercial forest land outside National Forests, by county and ownership, San Joaquin resource area, California, January 1, 1973. 36
9. Area of commercial forest land outside National Forests, by stand-size class, San Joaquin resource area, California, January 1, 1973 36
10. Area of commercial forest land outside National Forests by stocking percent, stand component, and cubic-foot site class, San Joaquin resource area, California, January 1, 1973 37
11. Area of commercial forest land outside National Forests by stockability limitation class, slope percent, and cubic-foot site class, San Joaquin resource area, California, January 1, 1973. 38
12. Area of commercial forest land outside National Forests, by forest type, San Joaquin resource area, California, January 1, 1973 39
13. Area of productive reserved forest land by forest type and ownership, San Joaquin resource area, California, January 1, 1973 40
14. Area of unproductive forest land in National Forests; in National, State, and county parks; in other public ownership outside parks; and in private ownership, by type or category, San Joaquin resource area, California, January 1, 1973 40

15. Area of commercial forest land; and net volume, net annual growth, and average annual mortality of growing stock and sawtimber outside National Forests, by stand age class, San Joaquin resource area, California, January 1, 1973 41

16. Net volume of growing stock and sawtimber on commercial forest land and average volume per acre, by ownership and softwoods and hardwoods, San Joaquin resource area, California, January 1, 1973. 42

17. Net volume of growing stock and sawtimber on commercial forest land outside National Forests, by forest type, San Joaquin resource area, California, January 1, 1973 43

18. Net volume of growing stock and sawtimber on commercial forest land outside National Forests by county and ownership, San Joaquin resource area, California, January 1, 1973 44

19. Net volume of growing stock and sawtimber on commercial forest land outside National Forests and average volume per acre, by stand-size class and by softwoods and hardwoods, San Joaquin resource area, California, January 1, 1973 45

20. Net volume of growing stock on commercial forest land outside National Forests, by species and ownership, San Joaquin resource area, California, January 1, 1973 46

21. Net volume of sawtimber on commercial forest land outside National Forests, by species and ownership, San Joaquin resource area, California, January 1, 1973 (International 1/4-inch rule). 47

22. Net volume of sawtimber on commercial forest land outside National Forests, by species and ownership, San Joaquin resource area, California, January 1, 1973 (Scribner rule). 48

23. Net volume of growing stock on commercial forest land outside National Forests, by species and diameter class, San Joaquin resource area, California, Janury 1, 1973. 49

24. Net volume of sawtimber on commercial forest land outside National Forests, by species and diameter class, San Joaquin resource area, California, January 1, 1973 (International 1/4-inch rule) 50

25. Net volume of sawtimber on commercial forest land outside National Forests, by species and diameter class, San Joaquin resource area, California, January 1, 1973 (Scribner rule) 51

26. Volume of timber on commercial forest land outside National Forests, by class of timber and by softwoods and hardwoods, San Joaquin resource area, California, January 1, 1973 52

27. Number of growing-stock trees on commercial forest land outside National Forests, by species and diameter class, San Joaquin resource area, California, January 1, 1973 53

28. Net annual growth of growing stock on commercial forest land, by ownership class, San Joaquin resource area, California, 1972 54

29. Net annual growth of growing stock and sawtimber on commercial forest land outside National Forests by species, San Joaquin resource area, California, January 1, 1973 54

30. Net annual growth of growing stock and sawtimber on commercial forest land outside National Forests, by forest types, San Joaquin resource area, California, January 1, 1973 55

31. Average annual mortality of growing stock and sawtimber on commercial forest land outside National Forests, by species, San Joaquin resource area, California 55

32. Reported timber production by county, San Joaquin resource area, and all of California, 1947-75 56

33. Confidence intervals for the estimates of forest area and timber volume outside National Forests, San Joaquin resource area, California, January 1, 1973. . 57

34. Approximate confidence interval by size of estimate, outside National Forests, San Joaquin resource area, California, January 1, 1973 57

THE SETTING

The San Joaquin resource area, with a total land area of 23.3 million acres, is comprised of three distinct geographic provinces: (1) the southern part of California's Great Central Valley, one of the richest agricultural regions in the world and containing the leading county (Fresno) in the Nation in gross value of agriculture (State of California, Documents Section 1975); (2) the dry eastern slopes of the Coast Ranges, an area of vast grasslands and brushfields; and (3) the Sierra Nevada and Tehachapi Mountains, rich in natural wonders such as Yosemite Valley and the giant sequoias[1] (fig. 1).

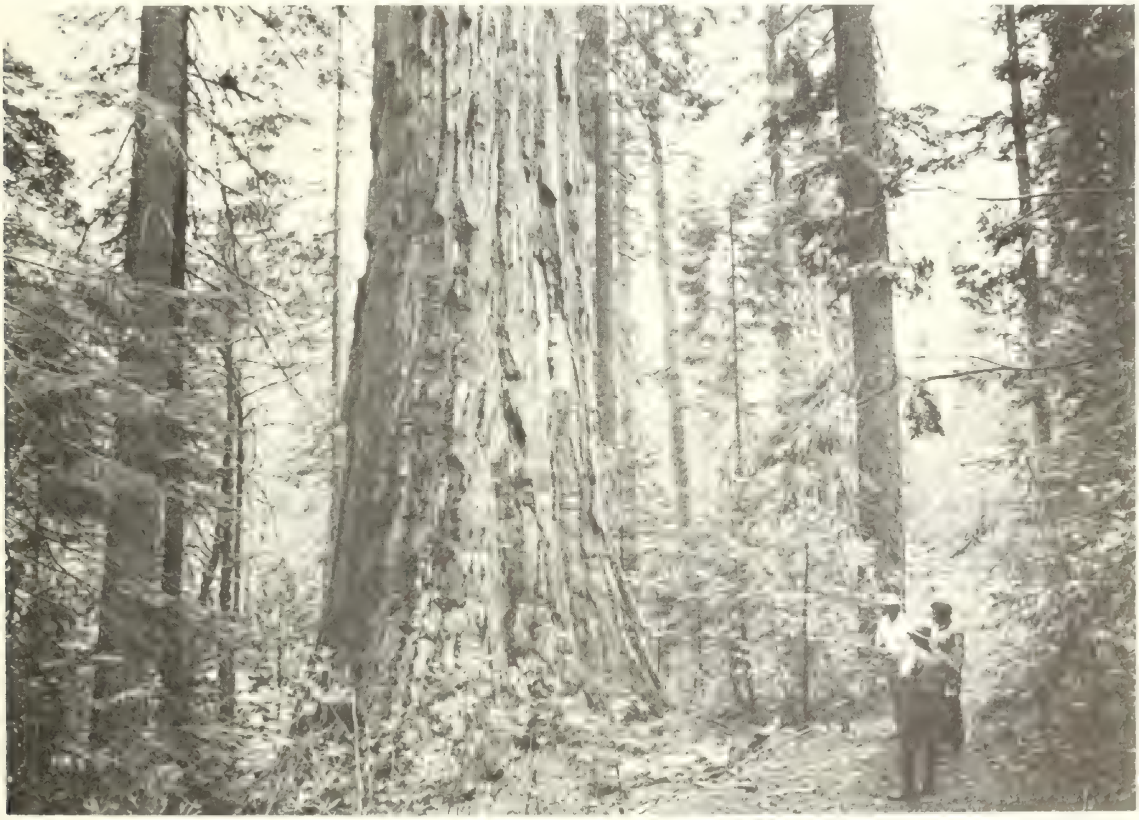


Figure 1.--A giant sequoia tree in the Sierra National Forest. This unique species is found in scattered groves in the higher elevations of the mixed conifer forests and lower elevations of the white fir-red fir forests.

Numerous cities cluster along the main highways in the Central Valley. Among the larger cities are Stockton, Fresno, Bakersfield, Merced, Lodi, Modesto, and Visalia. Smaller towns dot the western foothills of the Sierra Nevada and include history-rich places such as Sutter Creek, Angels Camp, Sonora, Columbia, and Coulterville.

---

[1] Scientific names of plants are listed under "Plant Species."

The population in 1975 in the 14 counties was 1.8 million persons, a 24-percent increase since 1960. The population increase for the entire State during this period was 33 percent.

Natural vegetation is extremely variable, reflecting the diversity in topography, climate, and soils (fig. 2). Mono County, east of the Sierra Nevada, and Kern County at the southern end of the region have more than 1-1/2 million acres of desert,[2] occupied by creosote bush, saltbush, greasewood, and other desert shrubs. Inland sagebrush-steppe amounts to three-quarter-million acres, mostly upslope from the desert in Alpine and Mono Counties. Coastal sagebrush covers more than one-half-million acres of the hills west of the Great Central Valley. Grassland, amounting to about 3-1/2 million acres, makes up the bulk of the lower foothill country, occurs as high mountain meadows (fig. 3), and is still found in some parts of the Valley. Much of the native grassland vegetation has been replaced by introduced species, including many annuals.

Forest, woodland, and chaparral extend over 7 million acres of the higher foothills and mountains. Included are brushfields and hardwood forests in the foothills west of the Sierra Nevada, juniper-pinyon pine in the upper reaches of the sagebrush-steppe, and the timber-producing coniferous forests from the upper foothills to the higher mountains.

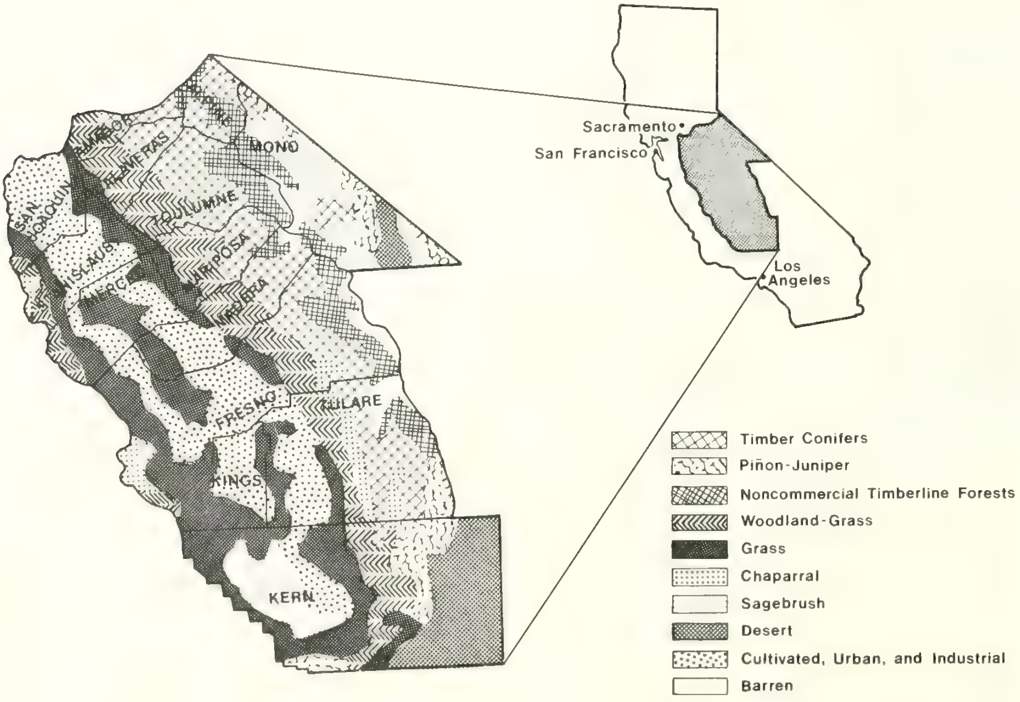
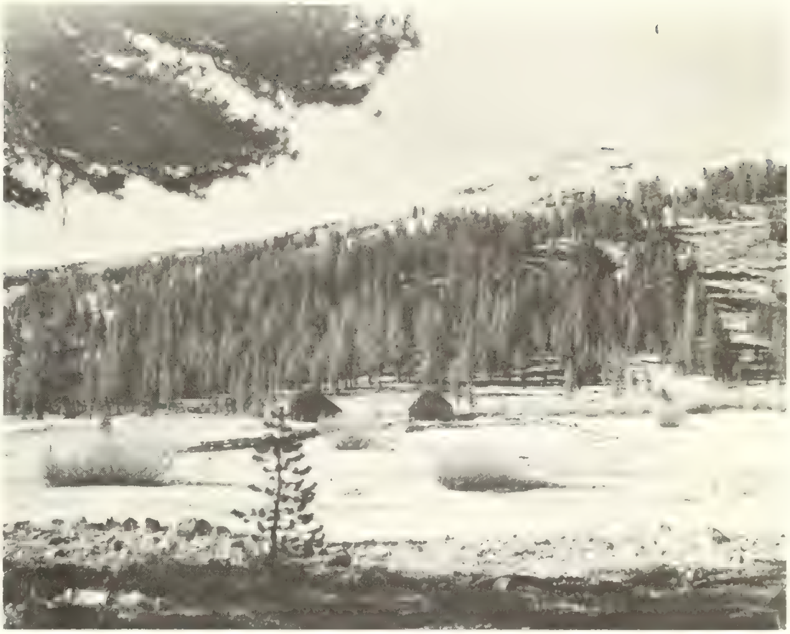


Figure 2.--Vegetation types of the San Joaquin resource area.

---

[2] The source for area information on nonforest types is the California Fish and Wildlife Plan (California Department of Fish and Game 1966).

Figure 3.--Mountain meadows and forest land east of the Sierra Crest in the Toiyabe National Forest. Such areas, though containing timber, are more important for summer livestock range, wildlife habitat, and recreational use.



Three major forest associations are within the coniferous forest zone: (1) Ponderosa and/or Jeffrey pine. Jeffrey pine occurs mostly east of the Sierra Nevada crest; ponderosa pine mostly on the western slopes in the midelevations to lower elevations. (2) Mixed conifer occurs in the midelevations and consists of various combinations of white fir, sugar pine, ponderosa pine, incense-cedar, and Douglas-fir (rare to absent in the south). (3) White fir and/or California red fir occurs in the higher elevations. Red fir stands often include mountain hemlock and western white pine in the higher elevations, and burned areas often restock to lodgepole pine. California black oak occurs in the lower part of the mixed conifer zone and also appears as scattered trees or in pockets among stands of ponderosa pine in the southern Sierra Nevada. At the upper reaches of the coniferous zone are the timberline forests of stunted, noncommercial trees.

Above the coniferous forests and mountain meadows are the barren, rocky peaks of the High Sierra, accounting for over 800,000 acres in the San Joaquin area.

Riparian vegetation in narrow stringers along streams in the lower canyons and the Valley occupies about 50,000 acres. This type is extremely important for wildlife. It is decreasing rapidly mainly because of agricultural development. The marsh vegetation type is important habitat for waterfowl, water birds, shore birds, and fur bearers, and is decreasing. Marshes cover about 130,000 acres, a fraction of their original area.

THE IMPORTANCE OF FORESTS IN THE SAN JOAQUIN RESOURCE AREA

Forests in the San Joaquin area contain a wealth of resources. Some resources--wildlife, water, and forage for example--are better labeled "forest-related" resources since they often cannot be singled out as products of forests alone. A brief sketch of the forest-related resource situation in the San Joaquin resource area follows.

1. *Outdoor recreation.*--The many outstanding scenic attractions and the vast area of land accessible to the public draw people from all over the United States and the world, as well as from the San Francisco and Los Angeles areas. In 1970 outdoor recreation activities accounted for 376 million participation days. By 1990 recreation use is projected to 640 million participation days--a 70-percent increase.[3]

2. *Water.*--Much of the water used in California originates as rain and snow on forest lands. The San Joaquin area is an important source of water. The total volume of developed water used in California in 1972 was 30.7 million acre-feet, of which the San Joaquin and Tulare Basins (these basins comprise most of the area covered in this report) supplied 11.0 million acre-feet. By 2020, the San Joaquin and Tulare Basins are projected to supply 12.2 million acre-feet, but this is 1.1 million to 6.3 million acre-feet short of projected demands from this region (California Department of Water Resources 1974).

3. *Wildlife.*--The area is rich in both game and nongame species. For example, there are an estimated 60,000 mule deer on four of the seven National Forests, and 17,000 bucks were bagged by hunters from 1969 through 1973. Hunter-days for all game amount to about 3 million or 30 percent of the State's total. About 40 percent of California's cold water fishing streams and 30 percent of its warm water fishing streams flow through the area.[4]

4. *Grazing.*--Livestock grazing is the predominant commodity use of the vast area of privately owned unproductive forest land. Grazing is also important on government lands, especially in the summer. In the San Joaquin area, exclusive of Mono County, about 8.4 million acres are grazed by 1.5 million cattle and 0.5 million sheep, about 35 percent of the State's total (see footnote 4).

---

[3] Source: State of California, Department of Parks and Recreation.

[4] U.S. Department of Agriculture, Forest Service. 1974. San Joaquin planning area guide. (Draft.) Reg. Off., San Francisco.

5. *Timber.*--From 1945 to 1975 about 15 billion board feet of timber were cut in the 14-county area (California Division of Forestry 1947-75). The recent timber harvest of 500 million to 600 million board feet is about 12 percent of the State's total timber harvest. Manufacturing of wood products from this timber provides jobs for about 9,000 people in the area.[5]

FOREST AREA AND OWNERSHIP

CURRENT FOREST AREA

About 7 million acres or 30 percent of the total land area in the 14 counties has been classified as forest land, 63 percent as nonforest-land, and 7 percent has not been classified. The following tabulation shows total acreage by land class and owner:

Land Class and Owner[6]	Acres	Percent of area
Commercial forest in National Forests	1,733,000	7.4
Commercial forest outside National Forests	512,000	2.2
Total commercial forest land	2,245,000	9.6
Productive reserved forest in National Forests	39,000	.2
Productive deferred forest in National Forests	17,000	.1
Productive reserved forest outside National Forests	615,000	2.6
Total productive reserved and productive deferred lands	671,000	2.9
Unproductive forest in National Forests	1,101,000	4.7
Unproductive forest in Parks outside National Forests	513,000	2.2
Unproductive forest outside National Forests and Parks	2,424,000	10.4
Total land classified as unproductive forest	4,038,000	17.3
Unproductive forest and nonforest land in National Forests (unclassified)[7]	1,586,000	6.8
Classified nonforest lands in National Forests	627,000	2.7
Nonforest land outside National Forests	14,149,000	60.7
Total land area	23,316,000	100.0

---

[5] Source: State of California, Employment Development Department.
[6] See "Definition of Terms," page 53.
[7] Much of this is wilderness.

PRODUCTIVE RESERVED AND DEFERRED FOREST LAND

Productive reserved forests are capable of growing at least 20 cubic feet of wood per acre per year, and are set aside in parks or Wilderness or other reservations. Within these reservations are some of the Nation's most spectacular scenery and most visited recreation spots, including Sequoia, Kings Canyon, and Yosemite National Parks, Devils' Postpile National Monument; John Muir, Minarets, and Domelands Wildernesses; High Sierra Primitive Area; and Calaveras Big Trees State Park.

Timber cutting for commodity production is prohibited in these reservations which, however, are used for various purposes. They are important as watershed and wildlife habitat, as well as for recreation. Hunting is not allowed in national parks, but many game animals that spend part of the year on park lands migrate to areas where they may be hunted (California Department of Fish and Game 1966). Many nongame species in the parks are viewed by thousands of visitors annually.

The timber productivity of these areas has not been estimated. The parks and Wilderness contain some very productive timberland, such as that in and near the giant sequoia groves. Extensive areas, generally at high elevations, with short-growing seasons and daily and annual temperature extremes, are poor timber sites. They are steep and rocky, and the soils are shallow. Such areas outside reservations have not been managed successfully for sustained timber production. The long-term value forgone in timber within these reservations is comparatively low.

Deferred forest lands are productive forest areas *in National Forests* that are being studied for possible Wilderness classification.

Of the 671,000 acres of productive reserved and deferred forest land, 609,000 acres or 91 percent are in Kings Canyon, Sequoia, and Yosemite National Parks (fig. 4).

Changes in Productive Reserved Forest

Between 1953 and 1973, productive reserved areas have increased 19,000 acres--18,000 acres in National Forest wilderness and about 1,000 acres in State and county parks. The total acreage in Wilderness and parks has increased by a much greater amount, but much of the area is not productive forest.

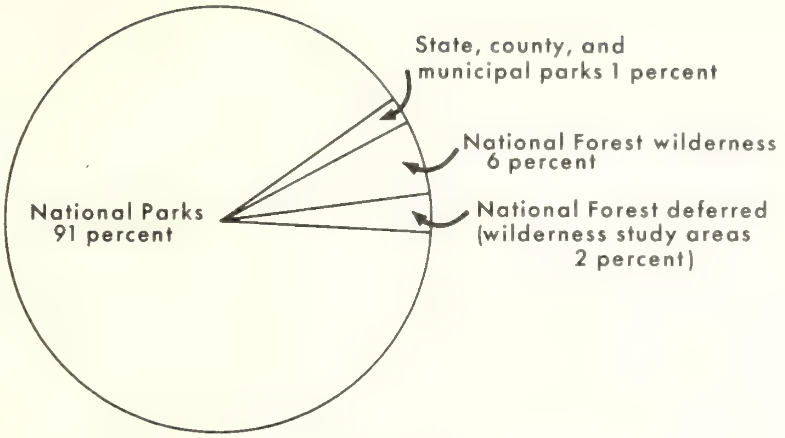


Figure 4.--Most of the productive reserved forest is in National Parks.

UNPRODUCTIVE FOREST LAND[8]

Of the 4,038,000 acres classified as unproductive forest land, 47 percent is held by farmers and miscellaneous private owners and 53 percent by public agencies (fig. 5).

Ownership of the unproductive forest land is significant from the standpoint of total resource planning and use. Unproductive forest cover on U.S. Forest Service and Bureau of Land Management (BLM) lands may be manipulated or removed for various resource management purposes. Conversely, the policy is that forest cover in National Parks and Wilderness must not be disturbed.

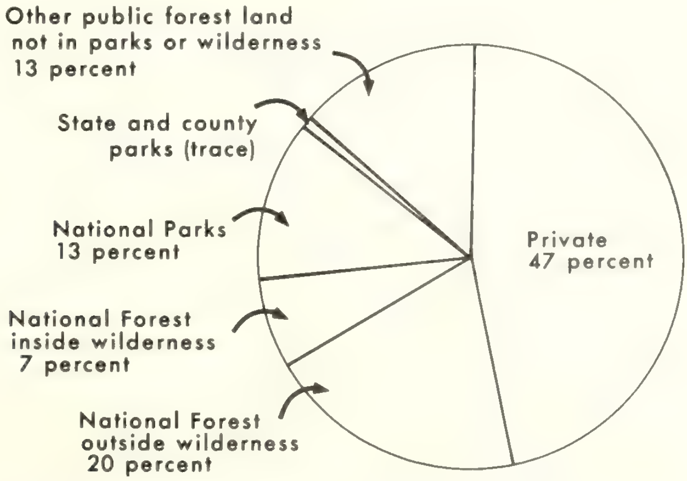


Figure 5.--Unproductive forest land is divided almost equally between private and public owners.

---

[8] Does not include unproductive forest in the 1,586,000 acres of unclassified National Forest land.

Subdivision and development for recreational and residential use of privately owned unproductive forest is increasing, especially in the oak and highly flammable chaparral types. One result is a reduction in the State-administered controlled burning of brushland to increase livestock grazing or improve wildlife habitat. This is caused in part by fear of liability for property damages, suppression costs in case a fire escapes and restrictions related to air pollution control (California Division of Forestry 1961-74). The reduction of controlled burning is thought to be related to the *increase* in the average annual acreage burned by wildfire caused by fuel buildup.

Unproductive Forest Types and Categories

Oak stands cover 1,838,000 acres or 46 percent of the unproductive forest land (fig. 6). They grow in the western foothills of the Sierra Nevada (fig. 7) and eastern slopes of the Coast Ranges. Blue oak, interior live oak, and canyon live oak are the most prevalent species, but California white oak and occasionally California black oak also occur in the unproductive oak type. Other tree species, such as Digger pine, California buckeye, California laurel, and mountainmahogany, and brush species are often present.

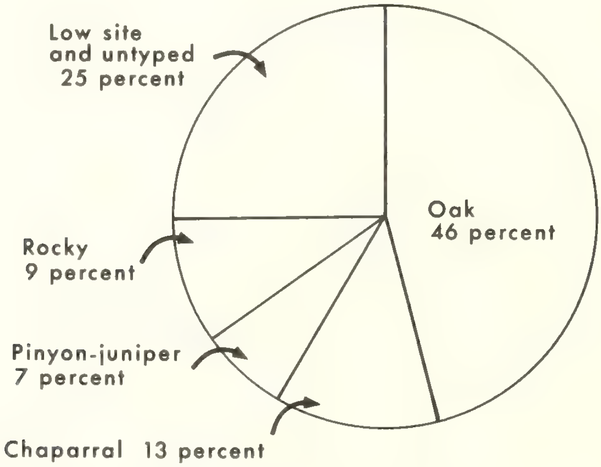


Figure 6.--Nearly half the unproductive forest land is occupied by oak.

Except for fuelwood and posts, little industrial use is made of the oak forests. Much of this type is grazed by livestock, and clearing to increase forage production is steadily reducing its area. Oak forests are important wildlife habitat, especially where they grade into chaparral. The highest year-round deer populations may be found in this type (California Department of Fish and Game 1966).

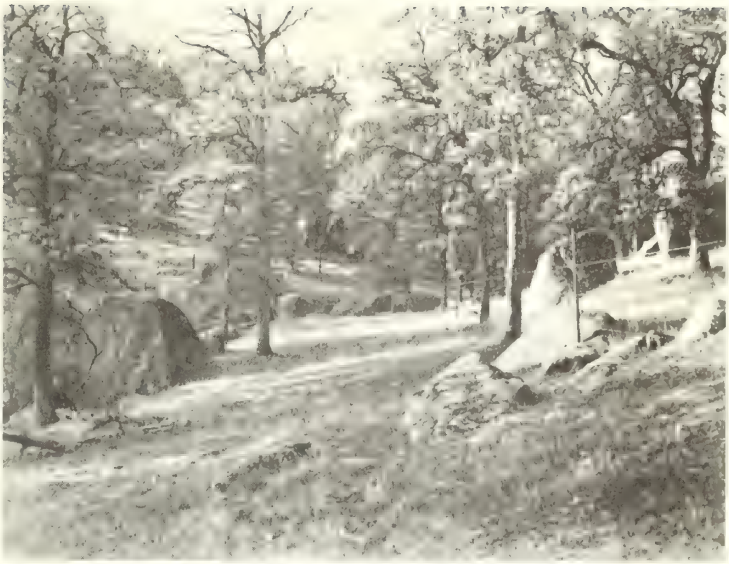


Figure 7.--Blue oak forest on private land in the western foothills of the Sierra Nevada. The area to the left of the fence has been heavily grazed.

Chaparral occupies 512,000 acres or 13 percent of the unproductive forest land in the lower foothills of the Sierra Nevada and at all elevations in the Coast Ranges. This type consists of tall brush or dwarf trees such as manzanitas, ceanothus, scrub or shin oak, chamise, California redbud, and toyon. Chaparral is typically dense, which limits the use of the land for grazing. For this reason, large areas of chaparral, as well as oak, have been cleared by burning and/or mechanical treatment. Burned areas often resprout and revert to chaparral. Wildlife populations are often high in chaparral, especially near type boundaries. Quail, rabbits, grey fox, and many other animals inhabit this type. In resprouting stands, deer browse is temporarily excellent (California Department of Fish and Game 1966).

The *pinyon-juniper* type occupies 292,000 acres or 7 percent of the unproductive forest in the dry eastern reaches of Tulare County, in eastern and southern Kern County, and east of the Sierra Nevada crest in Alpine and Mono Counties. This type is commonly associated with sagebrush, bitterbrush, and rabbit-brush on land that has potential grazing value which can be realized by clearing and seeding to grass. The pinyon-juniper type is important to many wildlife species, including quail, chukars, rabbits, band-tailed pigeons, and furbearers. It is especially important as deer winter range.

Rocky, unproductive forest lands total 368,000 acres or 9 percent of the unproductive forest. They are capable of growing 20 cubic feet or more of industrial wood per acre per year but are too steep or rocky for timber production. Examples are steep, timbered slopes along major rivers such as the Stanislaus, Mokelumne (fig. 8), and Kings Rivers, and boulder-strewn forests east of Huntington Lake. Much of the rocky, unproductive forest lands are in the National Parks.

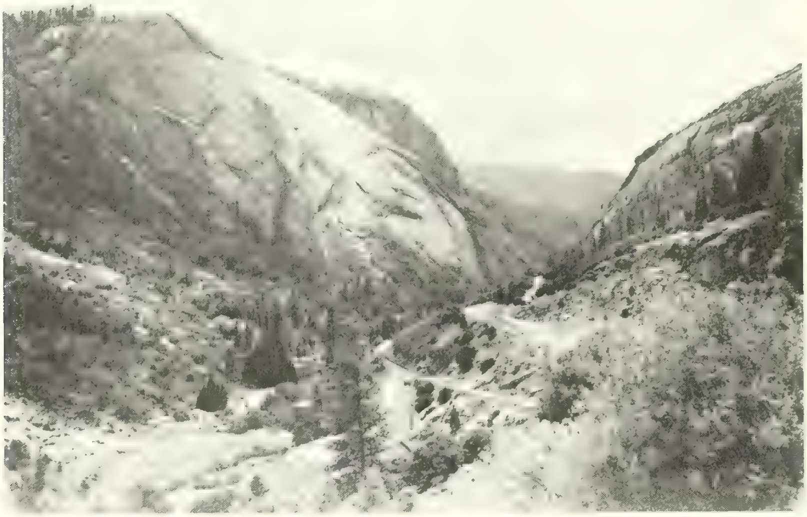


Figure 8.--Mokelumne River Canyon. Slopes along most of the major rivers in the Sierra Nevada are often too steep and rocky to manage for continuous timber production.

Land that can support commercial trees but not of sufficient size or in sufficient numbers to qualify as commercial forest is classified as "low site" unproductive forest. Such areas total 48,000 acres outside National Forests. There are 980,000 acres of unproductive forest land not specified by type within National Forests. The low site and untyped, unproductive forest lands total 1,028,000 acres or 25 percent of the unproductive forest area.

Changes in Unproductive Forest

The 1973 estimate of unproductive forest land is considerably lower than the USDA Forest Service's (1954) estimate in 1953.[9] Most of the reduction is due to clearing of oak and chaparral on private lands. From 1953 to 1972 about 340,000 acres were cleared by burning with or without mechanical or chemical treatment. About 50 percent were reburned to control sprouting, which resulted in a net acreage cleared of about 170,000 acres. About 25 percent of these areas were seeded to grass or clover (California Division of Forestry 1961-74). Wildfires burned about 130,000 acres of oak and chaparral during this same period (California Division of Forestry 1953-74). About 50 percent of these burned areas are assumed to have reverted to oak or chaparral, which leaves 65,000 acres of nonforest. The sum of the area cleared by controlled burning and wildfire is 235,000 acres.

---

[9] The 1953 estimates were based on work done by Wieslander and Jensen (1946).

Between 1953 and 1972, over 40 reservoirs were built, inundating about 68,000 acres,[10] mostly in the foothills of the Sierra Nevada (California Department of Water Resources 1972). These reservoirs replaced about 30,000 acres of oak and chaparral.

Urban development, road and powerline construction, and other factors also reduced the area of unproductive forest land, by an unknown amount.

COMMERCIAL FOREST LAND

Commercial forest land, as defined by the U.S. Forest Service, is capable of producing at least 20 cubic feet of industrial wood and has not been developed for nonforest use.

Of the total commercial forest land, 1,733,000 acres or 77 percent is in National Forests (fig. 9). Other public ownerships total 43,000 acres or 2 percent. They consist mainly of Mountain Home State Forest and Tule River Indian Reservation[11] in Tulare County and of scattered tracts of land administered by the Bureau of Land Management.

Commercial forest in private ownership totals 469,000 acres or 21 percent.

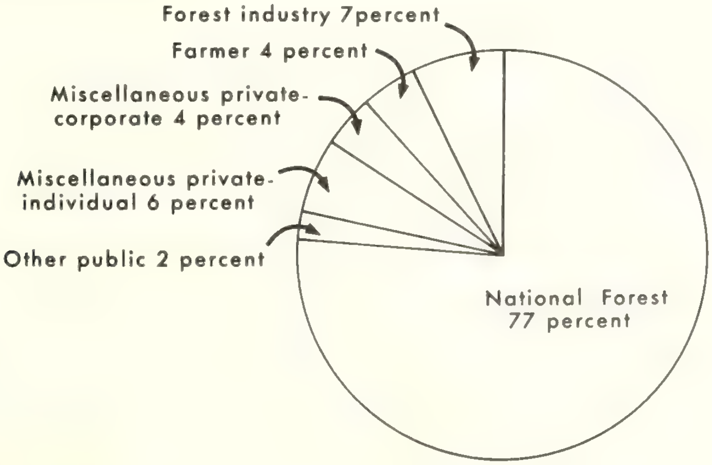


Figure 9.--Over three-quarters of the commercial forest land is in National Forests.

---

[10] New Melones Reservoir in Tuolumne and Calaveras Counties was not completed when this forest inventory was made, but its area--12,500 acres--is included.

[11] Indian lands are privately owned and are managed under the guidance of the Bureau of Indian Affairs. They are classified as public in this study in conformance with standard nationwide ownership definitions.

Changes in Commercial Forest Area, 1953-73

The following changes in commercial forest land occurred between 1953 and 1973:

National Forests[12]

Cause of change	Acres
Powerlines, reservoirs, roads	-6,900
Land exchanges	+2,000
Designated as Wilderness	-18,000
Deferred status (wilderness study areas)	-17,000
Net total	-39,900

Other Public and Private Lands

Cause of change	Acres
Physical changes to nonforest	-24,000
Land acquired by National Forests	-2,000
Reclassification to noncommercial forest	
1. Stockability factors	-21,000
2. West-side Sierra Nevada transition zone	-96,000
Undetermined causes	-58,000
Total change	-201,000

For other public and private lands, physical changes included clearing for grazing, residential-recreational developments, reservoirs, roads, and powerlines.[13]

Grazing developments were scattered along the western foothills of the Sierra Nevada, generally on low quality timberland. Residential-recreational developments were mostly on high quality timberland and were concentrated in a few scenic and easily accessible localities, such as the White Pine-Arnold area in Calaveras County and the Miwuk Village area in Tuolumne County. Changes caused by stockability factors were based on a method of estimating productivity in areas where tree stocking is limited by environmental factors (MacLean and Bolsinger 1973b, 1974).

---

[12] Source: U.S. Forest Service, Regional Offices for Regions 4 and 5.

[13] Determined from public records and by examination of 1972 plot locations on the 1953 timber stand maps (California Division of Forestry 1969) and aerial photographs.

Transition zone forests in the front country on the west slope of the Sierra Nevada consist of a mosaic of conifer stands, oak, chaparral, bare rocky hills, and steep canyons. Sample locations within this broad zone were spotted on the 1953 timber stand maps and were visited on the ground. Several plots typed as commercial timberland in 1953 were classified as unproductive forest in 1972. Of these plots representing a 96,000-acre reduction in commercial forest, 45 percent were in extensive areas completely devoid of conifers or of indications that conifers had ever grown there. Interior live oak, canyon live oak, blue oak, and Digger pine were the common tree species. An additional 27 percent were type "island" over an acre in size that contained no signs of commercial conifers but were within general areas supporting some commercial conifers. Eighteen percent supported scattered commercial conifers, usually short and poorly formed, growing in soil pockets among rocks, along drainages, or other microsites not large enough to qualify as commercial forest. Ten percent had obviously supported commercial conifers in the past but had been heavily disturbed; loss of the topsoil and changes in vegetation were judged permanent.

The front country of the Sierra Nevada has experienced a century and a quarter of mining, logging, burning, and grazing. Severe and repeated disturbance has caused extensive soil movement, altered the water table, and pushed back the commercial forest an average of 10 miles over much of the Mother Lode country.[14/] The prolonged dry cycle in the southern Sierra Nevada also is judged a contributing factor in the retreating forest type.[15/]

Records exist of ponderosa pine stands in areas that now support only oak, chaparral, and Digger pine. Local landowners cite examples of forest type changes within their lifetimes. Some of these areas may still be capable of supporting commercial conifers but only after expensive treatment. The oak and brush would have to be removed or thinned, a continuous problem because of their sprouting characteristics. Some shade would be needed to protect conifer seedlings, which would complicate matters. Rodents and other animals would have to be controlled. This is unlikely to happen. The general practice has been to convert these marginal types to range rather than timber. Estimates of timber volume were not affected, since these types generally contain no growing-stock trees.

[14/] Personal communication on August 6, 1976, with Wilmer Colwell, Director of the California Soils-Vegetation Survey project.

[15/] California Fish and Wildlife Plan, California Department of Fish and Game (1966), Vol. III, appendix--provisional projections of California areas and counties to 1980.

Timber Management Characteristics of the Ownerships

National Forest

National Forests are managed for continuous production of various commodities and amenities including outdoor recreation opportunities, water, fish and wildlife, timber, and forage for livestock. Timber management is planned within a framework of all recognized resource values. Timber is sold on the stump to purchasers who are required to remove trees according to a detailed contract. Through the contract, provisions are made to protect nontimber resource values, maintain timber yield, and minimize waste.

In the development of National Forest timber management plans (USDA Forest Service 1972), the total commercial forest area has been classified into four components of timber management intensity:

1. *Standard component* is regulated commercial forest land on which crops of industrial wood can be grown and harvested with adequate protection of forest resources under the provisions of the timber sale contract.

2. *Special component* is regulated commercial forest for which multiple use plans require specially designed treatment to achieve other resource objectives. Also included are areas where timber management activities are delayed pending multiple use planning and management decisions, travel and water influence zones, peripheral portions of developed sites, classified recreation areas, and areas where timber harvest is a secondary or minor management objective.

3. *Marginal component* is regulated commercial forest land not qualifying as "standard" or "special," primarily because of excessive development cost, low product value, or resource protection constraints. Included may be sites requiring unusual logging techniques (such as helicopters), areas where harvesting is blocked until roads are constructed, or areas with tree species not presently in demand. Also included is the backlog of nonstocked areas that would otherwise be classed as standard but that cannot be reforested without funding.

4. *Unregulated component* is commercial forest land that will not be managed for timber production under sustained yield principles. It includes:

   (a) experimental forests;
   (b) existing and planned recreation development sites, special interest areas, and administrative sites where timber harvest is not a major goal of management, such as ranger stations, guard stations, nurseries, etc.;
   (c) isolated tracts of commercial forest land where sustained periodic harvest is impractical.

The percentages of commercial forest land of National Forests with land in the San Joaquin resource area are:

Component	Percent
Standard	67.0
Special	9.4
Marginal	19.5
Unregulated	4.1

National Forest timber management practices vary, depending on the condition and productivity of the land, funding, and many other factors,[16] including devastating fires, storms, and forest pests. Detailed timber management plans are prepared for each National Forest and revised periodically.

Other Public Agencies

The Mountain Home State Forest is managed primarily to preserve and enhance giant sequoias. Under this objective an average annual harvest of 1.5 million board feet of pine, fir, incense-cedar, and hardwoods is allowed.

The Tule River Indian Reservation is managed under the guidance of the Bureau of Indian Affairs to provide income for the Indian owners. Timber is managed on a sustained-yield basis and is periodically cut; the long-term allowable annual harvest is 1 million board feet. The first cycle of cutting was completed in 1972. Currently, the forest is in a growth period with a corresponding low annual cut. From 1973 to 1975 the cut averaged 31,000 board feet.[17]

Lands administered by the Bureau of Land Management are managed for sustained yield under multiple use principles, as defined in the Federal Land Policy and Management Act of 1976 (Public Law 94-579). These lands are scattered parcels managed on a statewide basis. The statewide annual producing capacity of BLM commercial forest lands is estimated to be 51.3 million board feet. The cut is distributed to areas where the most mature timber is available. In 1974 and 1975 the annual cut on BLM land in the San Joaquin resource area averaged 905,000 board feet.[18]

---

[16] The recently passed National Forest Management Act of 1976 (Public Law 94-588) redirects the Forest Service in many management activities and also provides for additional funds for specific purposes.

[17] Personal communication with Edward A. Winsor, Area Forester, Bureau of Indian Affairs, Sacramento, California.

[18] Information provided by the BLM State Director's Office, Sacramento, California.

Privately Owned Commercial Forests

Forest industries own some of the highest quality forest lands in the San Joaquin resource area. Intensity of timber management varies from company to company. The long-term timber productivity of these lands is probably dependable. Investment in mills and land is some assurance that the companies will continue to grow timber. Uncertainties of the market and rising land prices may affect the future of timber management more than the present condition of these lands.

At the time this inventory was conducted, five timber companies owned 149,000 acres of commercial forest land in the San Joaquin resource area, as determined from the ownership sample. Over 80 percent of the commercial forest was owned by two large companies. Since the inventory, land belonging to a small company has been purchased by a large company, and some farmer and miscellaneous private forest land has been purchased by a large company. This is part of a continuing trend toward fewer and larger firms.

Most of the 102,000 acres of commercial forest land classed as farmer-owned is at lower elevations where conifer forests grade into oak and chaparral. Owners of the land on which several sample plots fell said they used the land primarily for grazing and considered trees a hindrance.

Miscellaneous private commercial forest land includes 87,000 acres owned by utility companies (such as Southern California Edison and Pacific Gas and Electric), banks and other financial institutions, land and real estate development companies, and churches and other organizations; 131,000 acres are owned by many individuals.

Some of these lands have been managed for timber on a rather extensive basis. Large areas are being subdivided and are changing owners at a rate that seems to preclude all long-term resource uses except for residential-recreational purposes (see "Future Timber Supplies", page 32).

Two recent State laws may change the trends in forestry on private lands: The Z'berg-Warren-Keene-Collier Forest Taxation Reform Act of 1976 (State of California 1976) is designed to encourage landowners to keep land in forestry use and to produce higher yields by discouraging premature cutting. The Z'berg Nejedly Forest Practices Act of 1973 (State of California 1974) is aimed at insuring that the productivity of private forest lands is maintained.

TIMBER-PRODUCING CONDITION OF THE COMMERCIAL FOREST LAND

FOREST LAND PRODUCTIVITY

Forests in the San Joaquin resource area are extremely variable in potential for production. There are sites in the arid transition zones on the eastern and western slopes of the Sierra Nevada and in the granitic high country that can produce only 20 to 50 cubic feet of wood annually. MacLean and Bolsinger (1974) showed that extensive areas in these zones are incapable of supporting 60 percent of normal tree stocking. Sample plot data indicate that trees in these difficult areas often are short and poorly formed.

Extensive areas of high quality timberland lie between the oak and chaparral on the lower western slopes of the Sierra Nevada and the granitic high country. Some of these better sites can produce over 165 cubic feet of wood annually.

Most of the poor sites in the lower foothills are in farmer and miscellaneous private ownership. Most of the poor sites in the high granitic country are in National Forests or National Parks. The National Forests also contain a sizable portion of the high quality timberland at the midelevations, though forest industry lands have the highest average timber growing capacity (see table 1, fig. 10). The best timber growing sites in private ownership tend to be concentrated in Amador, Calaveras, and Tuolumne Counties in the northern part of the resource area.

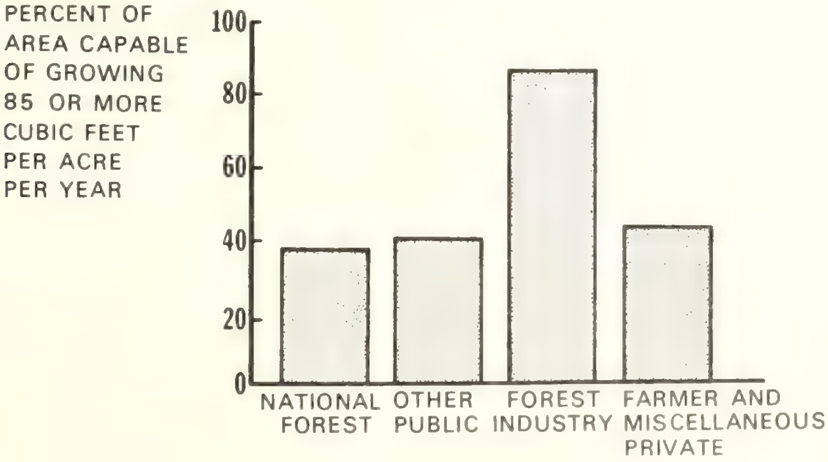


Figure 10.--Relative productivity of commercial forest land by ownership, San Joaquin resource area.

Table 1--*Area of commercial forest land by cubic-foot site class and ownership, San Joaquin resource area, California, January 1, 1973*

Ownership	Cubic-foot site class											
	20-49		50-84		85-119		120-164		165+		Total	
	Thousand acres	Percent	Thousand acres	Percent	Thousand acres	Percent	Thousand acres	Percent	Thousand acres	Percent	Thousand acres	Percent
National Forest:[1]												
Eldorado	1	3	5	16	9	29	13	42	3	10	31	100
Inyo[2]	11	13	46	51	21	23	8	9	4	4	90	100
Los Padres[2]	80	100	0	0	0	0	0	0	0	0	80	100
Sequoia	165	37	153	34	74	16	34	7	30	6	456	100
Sierra	67	13	224	42	132	25	56	10	55	10	534	100
Stanislaus	52	11	196	42	124	27	54	12	37	8	463	100
Toiyabe[2]	90	73	19	16	10	8	1	1	0	0	120	100
Total National Forest[2]	466	26	643	36	370	21	166	10	129	7	1,774	100
Outside National Forests:												
Other public	12	28	14	33	9	21	6	14	2	4	43	100
Forest industry	10	7	14	9	30	20	73	49	22	15	149	100
Farmer and miscellaneous private	97	31	88	27	55	17	56	17	24	8	320	100
Total outside National Forests	119	23	116	23	94	18	135	26	48	10	512	100

[1] Cubic-foot yield values shown for National Forests are based on appropriate yield tables for the major tree species but have not been adjusted for stockability limitations.

[2] Acreages shown for these National Forests include land outside the San Joaquin resource area.

The cubic-foot site classes shown in table 1 are useful for ranking the relative capacity of the land to produce wood under conditions represented by normal yield tables. They do not indicate the absolute yields that could be realized now or in the future.

Wood productivity is only one aspect of land capability relating to timber manageability. Two others are tree stockability limitations and steepness of slope. Factors that commonly limit tree stockability are soil moisture, temperature, toxicity, and physical obstructions such as rock (MacLean and Bolsinger 1973b). These factors are sometimes related to the success or failure of forest management activities, particularly regeneration (Waring et al. 1972, Fowells and Stark 1965, Griffin 1967).

Slope is related to soil erodibility and operating costs and may also affect nontimber values such as water and fisheries. In this study, slopes over 45 percent are considered difficult to manage regardless of stockability. Lands incapable of supporting 60 percent of full stocking, as shown in normal yield tables (Dahms 1964; Dunning and Reineke 1933; McArdle et al. 1961; Meyer 1961; Schumacher 1926, 1930), are considered difficult to manage regardless of slope.

Stockability and slope percent were examined on all plots established outside National Forests in the San Joaquin area. Table 11 and figure 11 show the results.

In the San Joaquin resource area, 324,000 acres or 63 percent of the commercial forest outside National Forests

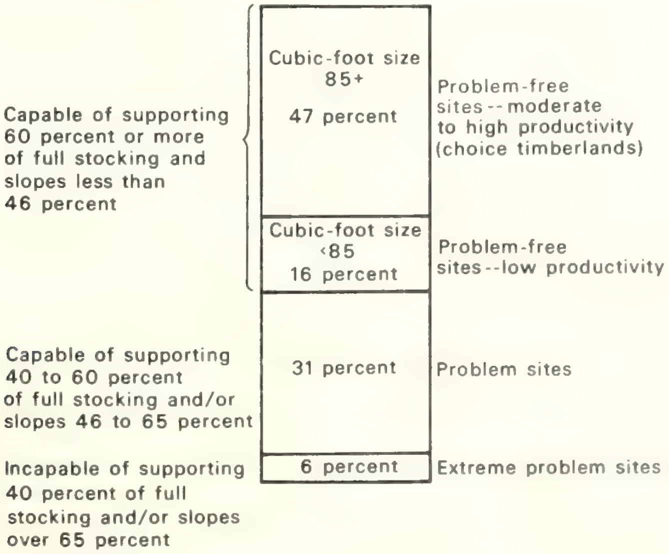

Capable of supporting 60 percent or more of full stocking and slopes less than 46 percent
Cubic-foot size 85+
47 percent
Problem-free sites--moderate to high productivity (choice timberlands)
Cubic-foot size ‹85
16 percent
Problem-free sites--low productivity
Capable of supporting 40 to 60 percent of full stocking and/or slopes 46 to 65 percent
31 percent
Problem sites
Incapable of supporting 40 percent of full stocking and/or slopes over 65 percent
6 percent
Extreme problem sites

Figure 11.--Medium and high site lands on flat to gently sloping ground make up 47 percent of the commercial forest outside National Forests.

is on slopes less than 46 percent and can support 60 percent or more of full stocking. Of this, 240,000 acres or 47 percent of the total area is capable of growing at least 85 cubic feet of wood per acre per year (fig. 11). These are the choice timberlands in terms of inherent productivity and freedom from management problems.

STOCKING CONDITION

Stocking data for National Forests are available only for reforestation backlog areas (see tabulation below). These are nonstocked lands for which reforestation funds have not been available. They amount to less than 3 percent of National Forest commercial forest lands (fig. 12).

National Forest	Acres in reforestation backlog	Percent
Eldorado	0	0
Inyo	1,200	1.0
Los Padres	900	5.4
Sequoia	19,400	4.6
Sierra	12,800	2.4
Stanislaus	8,600	1.9
Toiyabe	4,700	3.9
	47,600	2.7

Stocking data for lands outside National Forests are shown in table 2. They indicate that 4 percent is nonstocked

Table 2--*Area of commercial forest land outside National Forests by growing-stock conifer stocking class, cubic-foot site class, and ownership, San Joaquin resource area, January 1, 1973*[1]

(In thousand acres)

Growing-stock conifer stocking (percent of normal)[2]	Other public, cubic-foot site class		Forest industry, cubic-foot site class		Farms and miscellaneous private cubic-foot site class		All owners cubic-foot site class	
	85+	<85	85+	<85	85+	<85	85+	<85
0-10 (nonstocked)	--	2	--	--	--	18	--	20
11-35 (lightly stocked)	3	4	6	4	19	46	28	54
36-60 (moderately stocked)	3	7	9	5	31	34	43	46
61+ (fully stocked)	11	13	110	15	85	87	206	115
All stocking classes	17	26	125	24	135	185	277	235
Total acres	43		149		320		512	

[1] See page 67 for definition and criteria of stocking determination.

[2] 60 percent of normal is considered full-site utilization.

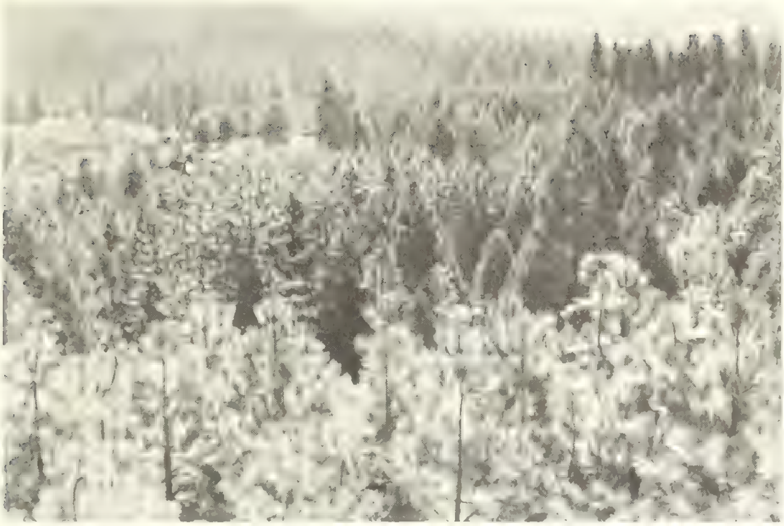


Figure 12.--Pine plantation on old brushfield near Fish Camp, Sierra National Forest. Because of successful fire control measures and reforestation efforts, less than 3 percent of National Forest commercial forest lands are nonstocked.

with conifers, 16 percent is lightly stocked, 17 percent is moderately stocked, and 63 percent is fully stocked.

Nonstocked lands produce little timber, but they are relatively insignificant in the San Joaquin resource area. All nonstocked lands outside National Forests are on sites incapable of growing 85 cubic feet per acre; most are below 3,000 feet in elevation (the better timberlands usually occur between 3,500 and 6,000 feet); over half are occupied to some degree by hardwoods and/or dense brush. About 90 percent of the nonstocked lands are in farmer and miscellaneous private ownership and 10 percent are in other public ownerships. No nonstocked forest industry lands were found.[19]

The nonstocked lands in farmer and miscellaneous private ownership in the San Joaquin resource area are not likely to be reforested. They are more likely to be converted to pasture.

Forest industry lands are in good condition; 84 percent are adequately stocked with conifers. Farmer and miscellaneous privately owned lands are in poorer condition; only 54 percent are adequately stocked with conifers and nearly 40 percent are at least moderately stocked with hardwoods. Other public owners, with only 43,000 acres, are represented by a small number of sample plots; hence, the reliability of the stocking data is low. The data indicate that the stocking distribution of other public lands is similar to farmer and miscellaneous private lands (see table 2).

---

[19] Since the fieldwork was completed, a fire burned about 5,000 acres of forest industry land. This area is being reforested by the company owning the land.

The stocking condition of the "choice" timberlands, as defined in "Forest Land Productivity" (page 17), looks like this:

Conifer Stocking

Adequate: 79 percent (13 percent of this is at least moderately stocked with hardwoods)

Moderate: 16 percent (69 percent of this is at least moderately stocked with hardwoods)

Light: 5 percent (80 percent of this is at least moderately stocked with hardwoods)

Nonstocked: None

Though the choice timberlands are generally in good condition, two undesirable situations exist: high mortality in white fir and a substantial area occupied by low-volume, low-value incense-cedar and hardwood trees (fig. 13). The white fir mortality seems to be a temporary phenomenon (see "Mortality," page 26). The incense-cedar-hardwood situation, however, may have a more lasting effect.

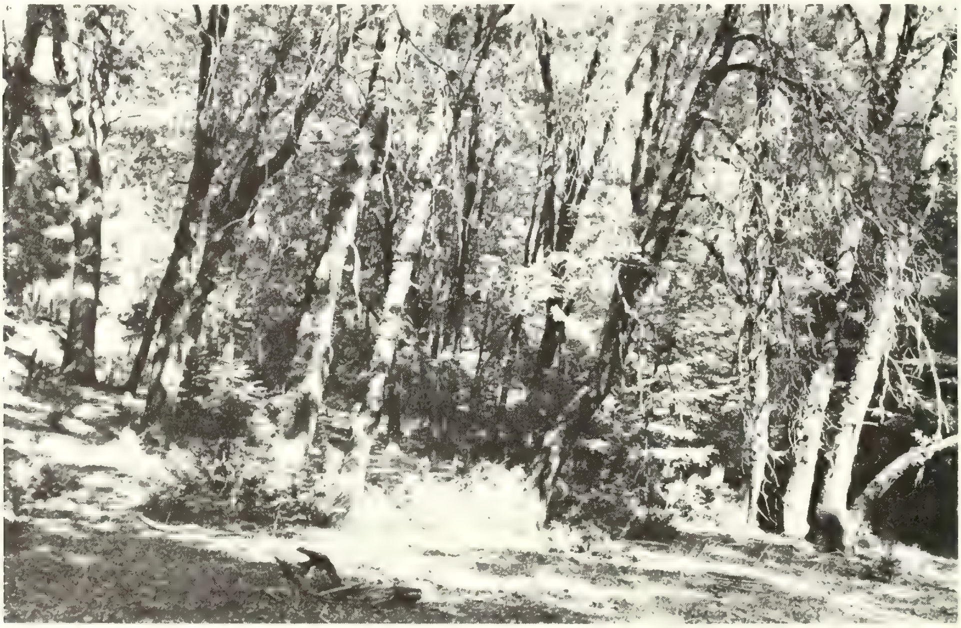


Figure 13.--California black oak stand with scattered understory conifers, Calaveras County. Such stands may be important wildlife habitat, but they are inefficient timber producers. Stand improvement would be expensive and the returns slow in coming.

Selective cutting in mixed conifer stands has been concentrated on the more valuable pines and firs. The former forest practice rules (California Division of Forestry 1968) allowed incense-cedar and hardwoods to be left as the predominant trees occupying stands after logging. As a result, about 40 percent of forest industry lands are now predominantly incense-cedar (30 percent) and hardwood (10 percent) type, based on plurality of stocking.

Table 27 indicates the effect of leaving incense-cedar and hardwoods. It shows that 54 percent of the softwood trees in the 2-inch diameter class are incense-cedar, and 63 percent of all species in the 2-inch class are incense-cedar and hardwood. Incense-cedar and hardwoods combined comprise the plurality through the 14-inch diameter classes. Although many hardwoods are on lower site lands at lower elevations, the stocking data show that 30 percent of the better sites are at least moderately stocked with hardwoods.

The current forest practice rules (State of California 1974) allow hardwoods and cedars to be counted as acceptable residual stocking following logging. Though the market for incense-cedar has improved over the years, this species is less efficient as a wood producer than are associated conifers. Data gathered in this study show that incense-cedar grows more slowly in diameter and is shorter than associated conifers for a given diameter. Often, it also has tapered and fluted boles resulting in lower usable volume for a given diameter and height. It occupies extensive areas where more productive species could be growing. Hardwoods often grow rapidly, but their form and space requirements limit their yield potential. No hardwoods were used in San Joaquin mills in 1972 (Howard 1974).

STAND SIZE AND AGE

Commercial forest land in the San Joaquin resource area is occupied primarily by sawtimber stands having trees with at least a 9.0-inch d.b.h. Large, old trees are still common, but, because of the long history of selective cutting on both private and public lands, undisturbed virgin stands are confined to high rugged mountains in a few unroaded areas. Many stands are classed as uneven aged. They may contain trees ranging from a few inches to over a hundred feet high and from a few years to 300 years old.

About three-fourths of National Forest lands are stocked with sawtimber-size trees (9.0-inch d.b.h. or greater), as shown in table 3.

The forests on private lands and other public lands are comparatively young. Though 87 percent are classed as sawtimber stands (table 9), over three-fourths are less than 100 years old. The structure of these stands reflects to a large degree the forest practice rules in effect before the Z'Berg-Nejedly Forest Practice Act was passed in 1973 (State of California 1974). Those rules required that all trees 22 inches in d.b.h. or smaller (18 inches or smaller in Alpine and Mono Counties) be left in selective cutting.

Table 3--*Area of commercial forest land by stand size class in National Forests in the San Joaquin resource area, 1973*
(In thousand acres)

National Forest	Sawtimber	Poletimber	Saplings and seedlings	Nonstocked	Total
Eldorado	31.0	0	0	0	31.0
Inyo[1/]	88.1	.6	0	1.2	89.9
Los Padres[1/]	67.3	6.6	2.7	3.9	80.5
Sequoia	266.9	136.8	33.2	19.4	456.3
Sierra	318.5	163.2	39.6	12.8	534.1
Stanislaus	433.1	1.4	20.7	8.6	463.8
Toiyabe[1/]	112.6	1.2	1.8	4.7	120.3
Total	1,317.5	309.8	98.0	50.6	1,775.9
Percent	74	17	6	3	100

[1/] Acreages shown for these National Forests include land outside the San Joaquin resource area.

Recent cutting has been heavier on forest industry lands than on farmer and miscellaneous private lands. This partly accounts for the larger area in uneven-aged stands on forest industry lands (75 percent of the ownership) than on farmer and miscellaneous private lands (56 percent). Most of the stands that originated after mining, burning, or logging from 1860 to 1925 were even aged until selective cutting allowed new trees to become established (Dunning and Reineke 1933). Many stands on farmer and miscellaneous private lands have not been disturbed enough to change their even-aged character.

TIMBER VOLUME

The total estimated volume of growing stock on all ownerships in the San Joaquin resource area is about 8.3 billion cubic feet and 47.4 billion board feet (Scribner rule). About 96 percent of the cubic-foot volume and 97 percent of the board-foot volume is in softwood species.

National Forests, with 77 percent of the commercial forest area, have 83 percent of the total cubic-foot volume (fig. 14) and 86 percent of the Scribner board-foot volume.

Since 1953 the softwood sawtimber inventory on National Forests has declined about 12 percent, and the inventory on private lands has declined about 33 percent. The main cause of the reduction in inventory was removal of old-growth trees for timber products. Less important causes were fires, pests, nonforest conversions, and withdrawals.

The bulk of the volume in trees 5.0-inch d.b.h. and larger is in a few species (fig. 15).

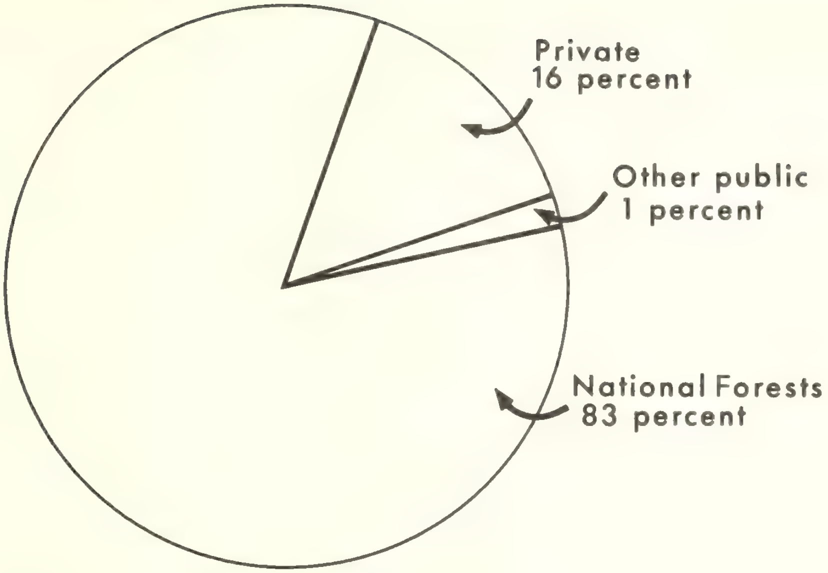


Figure 14.--Percentage of cubic-foot volume by ownership, San Joaquin resource area, January 1, 1973.

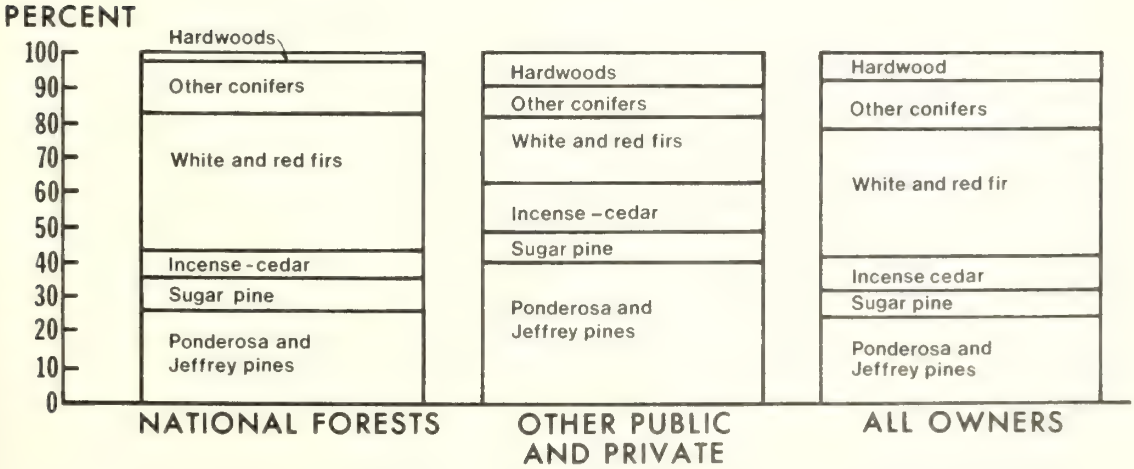


Figure 15.--Percentage of cubic-foot volume by species and ownership class, San Joaquin resource area, January 1, 1973. Percentages for National Forests were determined on the basis of total volume in the seven National Forests lying partially or entirely within the San Joaquin resource area.

GROWTH AND MORTALITY

GROWTH

Net annual growth of growing-stock trees in National Forests in the San Joaquin area is about 72 million cubic feet. Over 99 percent of this is softwoods. This gives an average of about 42 cubic feet per acre per year.

On lands outside National Forests the total estimated net annual growth is 28.9 million cubic feet (27.1 million of softwoods and 1.8 million of hardwoods). Growth of all species averages about 56 cubic feet per acre per year.

On lands outside National Forests nearly half the net annual cubic-foot growth is in ponderosa and Jeffrey pines (fig. 16).

MORTALITY

Current annual mortality of growing-stock trees on National Forests is estimated at about 23 million cubic feet, roughly 13 cubic feet per acre.

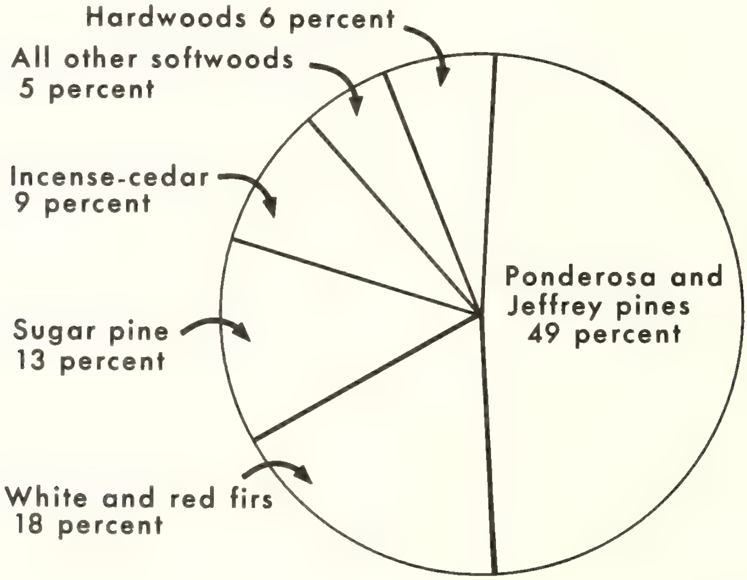


Figure 16.--Percent of net annual cubic-foot growth by species on lands outside National Forests in the San Joaquin resource area, January 1, 1973.

On lands outside National Forests, current annual mortality of growing-stock trees is estimated to total 5,929,000 cubic feet, about 12 cubic feet per acre. By ownership, annual mortality averages 6 cubic feet per acre on other public lands, 8 cubic feet per acre on farmer and miscellaneous private lands, and 22 cubic feet per acre on forest industry lands.

The heavy mortality on forest industry lands was mainly concentrated in smaller than average white fir (about 60 percent)--mostly in stands that had been logged in the past 10 years. Extensive logging damage had occurred in nearly all stands in which white fir mortality was high. White fir is more vulnerable to mechanical damage and subsequent attack by mortality agents than is ponderosa pine. Sunscald, bark beetles, butt rots, and top rots may all be induced by logging damage and may cause death many years later (USDA Forest Service 1965).

The high mortality is not considered a serious long-term problem. Industry lands are generally well stocked, and the white fir mortality has relatively little effect on the long-term growth in these stands. This mortality is a lost timber resource, but of relatively small magnitude. In these heavily roaded industrial timberlands more of the mortality could be salvaged, but its scattered nature and the fact that it tends to be concentrated in smaller trees makes recovery economically unattractive.

White fir and California red fir and incense-cedar have relatively high mortality rates.

Species	Net annual cubic-foot growth as a percent of total species volume	Current annual cubic-foot mortality as a percent of total species volume
Ponderosa and Jeffrey pines	2.4	0.4
White fir and California red fir	1.7	.7
Sugar pine	2.8	.1
Incense-cedar	1.5	.8
Other softwoods	1.4	.1
Hardwoods	1.4	.1
All species	2.0	.4

Figure 17 shows the distribution of mortality by species.

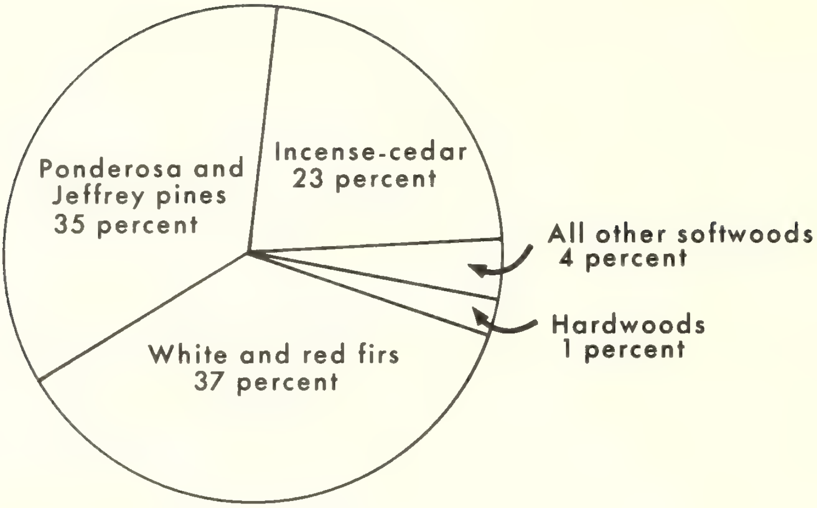


Figure 17.--Percent of average annual mortality by species on lands outside National Forests in the San Joaquin resource area, 1973.

For all lands outside National Forests over half the mortality was attributed to weather, insects, diseases, and logging.

Cubic-foot mortality

Cause	Percent
Weather	19
Insects	18
Disease	10
Logging	9
Suppression	5
Animals	1
Unclassified or unknown	38
	100

Mortality statistics shown are only for trees 5.0 inches in d.b.h. and larger. Though mortality of smaller trees is insignificant from a volume standpoint, it is significant to successful timber management. Many insects, diseases, animals, and other agents that have little effect on large trees do, however, kill millions of small trees annually. Small trees are becoming more important as larger acreages are placed under young-growth management.

TIMBER HARVEST AND CONSUMPTION AND INDUSTRIAL EMPLOYMENT

TIMBER HARVEST

Annual timber harvest in the San Joaquin resource area has remained fairly constant at 400 million to 600 million board feet for more than 25 years (California Division of Forestry 1947-75). The 1972 cut--596 million board feet--was about 12 percent of California's total.

National Forests have contributed an increasing proportion of the timber harvested as the cut on private lands has decreased. In 1953, the National Forest cut was 26 percent of the total, compared with 84 percent in 1973 (fig. 18). In 1973 other public lands provided about 1 percent and private lands 15 percent.

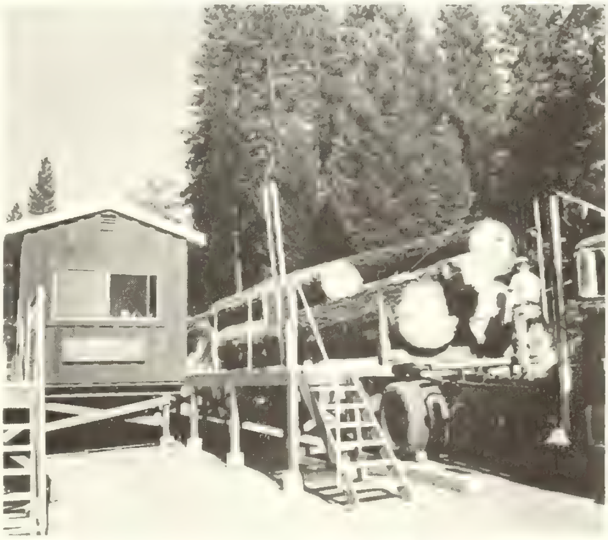


Figure 18.--Timber from National Forests, such as that shown at this U.S. Forest Service scaling station, amounts to over 80 percent of the total timber processed by mills in the San Joaquin resource area.

With the shift in cut overtime from private to public lands has come some redistribution of cut by county. In Fresno, Madera, Kern,[20] and Tulare Counties in the southern part of the area, the cut was increased by over 100 million board feet. In Calaveras County in the north, the cut dropped nearly as much as it increased in the four southern counties.

LOG CONSUMPTION

In 1972, about 600 million board feet of logs were processed by forest products industries in the San Joaquin resource area. Logs were used by 28 lumber mills,[21] 2 veneer and plywood mills, 2 post-pole-piling plants, and an export facility (Howard 1974). Two pulp and board plants also operated in the area; they used residues in the form of chips, sawdust, shavings, and bark from other mills.

---

[20] Includes small amount in Ventura County.

[21] In 1976 there were 21 lumber mills in the area.

A considerable shift in the species mix has also occurred, as shown in table 4.

More changes may occur in the future. The high current growth rates in ponderosa, Jeffrey, and sugar pines suggest that the availability of these species may hold steady or increase. Table 27, however, shows more incense-cedar, white fir, and hardwoods in the small diameter classes.

Historical data, along with current inventory and growth data, suggest cycles in which pines are plentiful alternated with cycles in which other species are plentiful.

Nontimber developments at the lower elevations where ponderosa pine stands predominate may eventually reduce the availability of this species. Changing market conditions and/or changing availability could bring about the use of some unused "other conifers" that make up 14 percent of the inventory.

Table 4--*Timber consumption by species, San Joaquin resource area, 1946, 1956, 1962, 1968, and 1972*[1]

(In percent)

Year	Ponderosa, Jeffrey, and sugar pines	White and red firs	Douglas-fir	Incense-cedar	Other species	Total
1946	67	25	4	4	--	100
1956	53	39	1	5	2	100
1962	59	34	2	[2]5	[2]	100
1968	47	47	2	[2]4	[2]	100
1972	43	44	1	12	--	100

[1] Sources: Forest Survey Release 6 (Burks et al. 1948).
Forest Survey Release 35 (May and Baker 1958).
California Timber Industries--1968 (Barrette et al. 1970).
Resource Bulletin PNW-52 (Howard 1974).
Resource Bulletin PSW-2 (Muerle and Hornibrook).

[2] Incense-cedar and other species combined.

EMPLOYMENT IN FOREST INDUSTRIES

Employment in forest industries in the San Joaquin resource area totaled 8,864 persons in 1972 and 9,228 in 1975.[22] This is about 10 percent of the total reported forest industrial employment in California.[23]

---

[22] Standard industrial codes 2411-2499 and 2611-2661, U.S. Office of Management and Budget (1972).

[23] Source: State of California, Employment Development Department.

In the 14 counties as a whole, forest industries contribute only 2 percent to total employment and 11 percent to manufacturing employment. For some counties and especially for certain mountain communities, forest industries provide a significant portion of total employment.

The reported forest industrial employment includes employment in milling and logging, but excludes some trucking. Forestry positions in government agencies and companies not classified as wood products industry are also excluded. Of the forest industrial employment, logging accounted for 4 percent, sawing and planing mills 28 percent, all paper and allied products 27 percent, and veneer and plywood and all others 41 percent.

Total forest industrial employment has increased from about 7,300 in the early 1960's to over 9,000 in 1974. The major increase has been in paper and allied products and wood products manufacturing other than sawing and planing (fig. 19). New and expanded facilities are responsible for the increase.

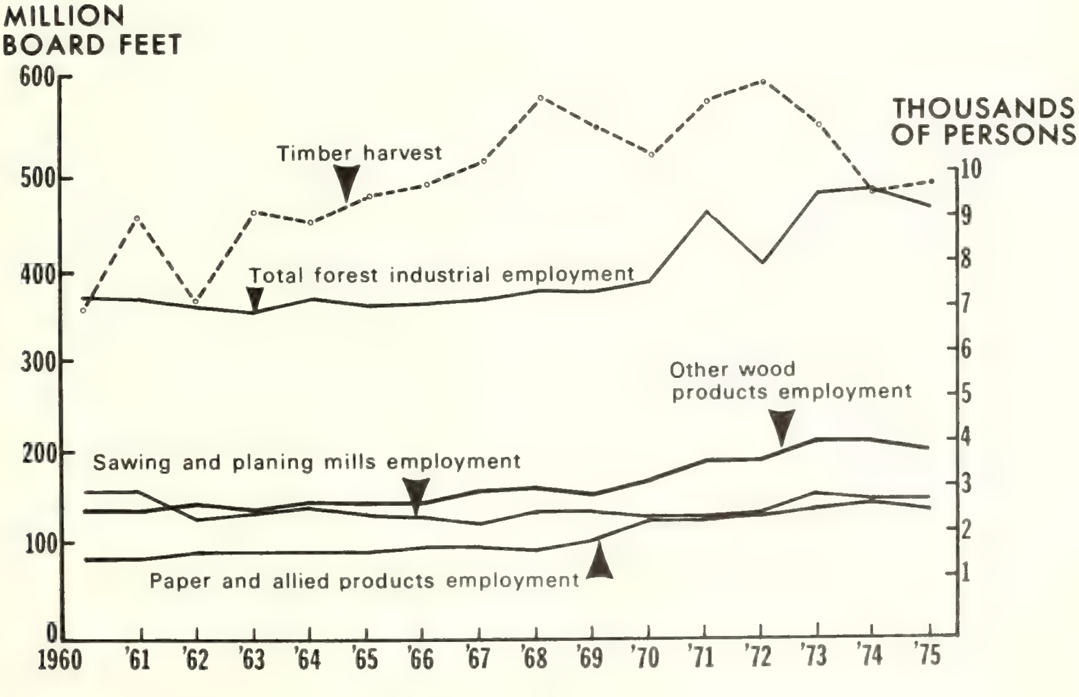


Figure 19.--Timber harvest and forest industrial employment, San Joaquin resource area, 1960-75.

FUTURE TIMBER SUPPLIES

National Forests provide over 80 percent of the timber processed by mills in the San Joaquin resource area and are therefore the key to a continued supply of industrial wood. The future allowable timber harvest from National Forests can be expected to change as new data on yields and management response become available, and as land use policies evolve.

The best estimate of current sawtimber growth is about 285 million board feet (Scribner rule). The annual yield targets are based on the estimated potential yield for each commercial forest component. They are not necessarily in balance with the current growth because of unequal age class distribution, overmature timber stands, and poor stocking condition of stands not yet placed under management. Table 5 shows the total potential yield and net annual growth estimates for the five National Forests that make up the bulk of the commercial forest in the San Joaquin resource area.

Table 5--*Potential yield and net annual growth*[1/] *by National Forest and commercial forest land component, San Joaquin resource area, California*

(In million board feet, Scribner rule)

National Forest	Commercial forest					Current net annual growth
	Standard	Special	Marginal	Unregulated	Total	
Inyo	8.1	0.1	3.3	--	11.5	12.5
Sequoia	104.5	7.0	6.6	--	118.1	49.1
Sierra	141.9	9.7	8.3	--	159.9	49.9
Stanislaus	120.1	10.1	26.8	5.0	162.0	162.3
Toiyabe	12.4	.2	10.2	.2	23.0	12.6
Total	387.0	27.1	55.2	5.2	474.5	279.4

[1/] USDA Forest Service 1976.

In 1972, 474.8 million board feet of National Forest timber was processed in mills in the area (Howard 1974), nearly identical to the total potential yield from all commercial forest components.

Since the full yield potential can usually be cut only from the standard component, the actual cut will normally be less than the total yield potential from all components. National Forest cut has declined since 1972.

The reasons include shortage of administration funds and personnel and delays caused by land use planning and litigation.

National Forest timber cut may decline even further if wilderness areas increase. In addition to the 17,000 acres of productive forest in deferred areas being studied for wilderness inclusion, about 137,000 acres of productive forest in roadless areas are to be reviewed for possible Wilderness designation. Estimated timber volume in these areas is 3 billion board feet, and potential yield is about 39 million board feet per year, about 8 percent of the total for National Forests in the San Joaquin resource area. How much of this will be removed from the timber-producing portion of the forest remains to be seen.

The National Forests, though managed for many resources other than timber, are the only lands for which timber production is ordered by law (National Forest Management Act of 1976). The law does not specify an exact amount of timber to be produced. In fact, it outlines conditions that must be met before harvest levels can be increased; it also specifies situations under which harvest levels must be decreased. Before the longrun timber productivity of these lands can be determined, more information on management techniques and response, resource interactions, and demand for the various outputs is needed.

Farmer and miscellaneous privately owned lands are producing considerably less wood than they could. Although their growth is three times their cutting rate and their inventories are larger than forest industry's, they are supplying about 25 percent less timber to mills. Many opportunities exist to produce more wood from these lands, but many owners apparently have objectives other than growing timber.

Recreational-residential development and forest clearing for grazing continue to reduce the timber-growing area in farmer and miscellaneous private ownerships. The forest area estimates in this report include tracts of land being developed for nontimber use when the fieldwork for this report was done. Clearing or construction work had begun in the immediate vicinity of many sample plots, but the plots had not yet been converted to nonforest. These potential conversions, based on the sample, amounted to 40,000 acres and contained 280 million board feet of softwood timber (Scribner rule), about 9 percent of the area and 5 percent of the volume in all private ownerships. The growth loss by these conversions will be about 2.4 million cubic feet annually or 9 percent of the net annual growth on all private lands.

About 60 percent of the conversions were for recreational-residential development, and 40 percent were for grazing or other agricultural use. Recreational-residential developments were often at the midelevations, and, on the average, replaced better quality timberland than grazing clearings which were generally in the lower forest fringe zone. The average productive capacity of the recreational-residential sites was 74 cubic feet per acre per year compared with 44 cubic feet for the grazing developments. Projected increased demand for meat and predicted losses of Central Valley grazing lands (California Department of Water Resources 1974) to agriculture and urban developments indicate that there will be a growing demand for pasture. Since livestock grazing will yield quicker returns than timber, a continued loss of forest to pasture clearing can be expected.

Predicting the future of recreational and residential development in forest areas is difficult. It appears these developments will continue, and, in some areas, they may usurp use of the land for grazing as well as for timber.

On forest industry lands growth and cut are nearly equal. For several decades the mixed-age stands have been yielding timber, mostly on a selective cut basis. It appears they could continue to do so indefinitely. Some changes in the resource situation should be considered. Included are a growing scarcity of large trees and a changing mix of species. Incense-cedar and hardwoods may become a management problem in some areas.

Though growth and cut are nearly in balance, forest industry lands are apparently producing less than their potential. If investments were made to increase yields on these lands, the payoff would be decades from now. In the meantime, pressures for developing other private lands for nontimber use may begin to erode the forest industrial land base.

The continued loss of forest accentuates the importance of intensive management of remaining forest lands. If the 240,000 acres of "choice" timberlands (see page 20) in private ownerships were managed so that they produced only 80 percent of their estimated potential, they could yield 25 million cubic feet annually. This is roughly equal to the current growth on the entire 512,000 acres of commercial forest outside National Forests, and 15 to 20 percent greater than the current timber harvest.

There seems little incentive for private landowners in the San Joaquin area to make forestry investments. Land use trends suggest, however, that intensified forest management on lands dedicated to timber production is needed to prevent a timber shortage in the future.

Table 6--Area by land class for all National Forests and for all lands outside National Forest by county, San Joaquin resource area, California, January 1, 1973

(In thousand acres)

Land class	National Forests	Outside National Forests															Total[1]
		Total	Alpine	Amador	Calaveras	Fresno	Kern	Kings	Madera	Mariposa	Merced	Mono	San Joaquin	Stanislaus	Tulare	Tuolumne	
Forest land:																	
Commercial	1,733	512	18	64	134	36	35	--	15	45	--	7	--	--	43	115	2,245
Deferred	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17
Productive reserved	39	614	1	2/	2	72	--	--	37	115	--	--	--	--	184	203	654
Unproductive	1,101	2,937	24	112	253	363	531	12	193	361	37	61	26	117	551	296	4,038
Total	2,890	4,064	43	176	389	471	567	12	247	521	37	68	26	117	779	614	6,954
Nonforest land	627	14,149	25	130	180	2,369	4,295	881	726	228	1,215	717	879	847	1,430	224	14,776
Unproductive forest and nonforest (unclassified)	1,586	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,586
Total area[1]	5,103	18,213	68	306	569	2,840	4,862	893	973	749	1,252	785	905	964	2,209	838	23,316

Source: United States Bureau of the Census, Land and Water Area of the United States, 1971.

[1] Totals may be off because of rounding.

[2] Less than 500 acres.

Table 7--*Area of commercial forest land by ownership, San Joaquin resource area, California, January 1, 1973*

Ownership	Thousand acres	Percent
National Forest	1,733	77.2
Other public:		
Bureau of Land Management	22	1.0
Bureau of Indian Affairs	13	.6
State	7	.3
County and municipal	1	--
Total other public	43	1.9
Private:		
Forest industry	149	6.6
Farmer	102	4.6
Miscellaneous private--corporate	87	3.9
Miscellaneous private--noncorporate	131	5.8
Total private	469	20.9
Total all ownerships	2,245	100.0

Table 8--*Area of commercial forest land outside National Forests, by county and ownership, San Joaquin resource area, California, January 1, 1973*

(In thousand acres)

County	Other public	Private	Total
Alpine	2	16	18
Amador	1	63	64
Calaveras	8	126	134
Fresno	1	35	36
Kern	1	34	35
Madera	--	15	15
Mariposa	1	44	45
Mono	1	6	7
Tulare	21	22	43
Tuolumne	7	108	115
All counties	43	469	512

Table 9--*Area of commercial forest land outside National Forests, by stand-size class, San Joaquin resource area, California, January 1, 1973*

Stand-size class	Thousand acres
Sawtimber stands:	
Large sawtimber[1]	197
Small sawtimber[2]	247
Total	444
Poletimber stands	9
Sapling and seedling stands	50
Nonstocked areas	9
All classes	512

[1] Large sawtimber includes trees 21.0 inches in d.b.h. and larger.

[2] Small sawtimber includes softwood trees 9.0 to 20.9 inches in d.b.h. and hardwood trees 11.0 to 20.9 inches in d.b.h.

Table 10--*Area of commercial forest land outside National Forests by stocking percent, stand component, and cubic-foot site class, San Joaquin resource area, California, January 1, 1973*

(In thousand acres)

Stocking percent in softwood growing-stock trees	Stocking percent in hardwood and cull softwood trees					
	0-10 percent	11-35 percent	36-60 percent	61-80 percent	81+ percent	Total[1]
0-10 percent:						
High site[2]	0	0	0	0	0	0
Medium site	0	0	0	0	0	0
Low site	10	7	2	0	1	20
Total	10	7	2	0	1	20
11-35 percent:						
High site	0	2	3	0	0	5
Medium site	0	5	7	0	11	23
Low site	11	8	18	12	5	54
Total	11	15	28	12	16	82
36-60 percent:						
High site	2	0	3	0	0	5
Medium site	4	4	10	20	0	38
Low site	12	8	11	5	9	45
Total	18	12	24	25	9	88
61-80 percent:						
High site	0	1	3	0	0	4
Medium site	6	11	15	5	0	37
Low site	8	7	10	0	0	25
Total	14	19	28	5	0	66
81+ percent:						
High site	21	14	0	0	0	35
Medium site	70	53	7	0	0	130
Low site	44	37	10	0	0	91
Total	135	104	17	0	0	256
Total:						
High site	23	16	9	0	0	48
Medium site	80	73	40	25	11	229
Low site	85	67	50	18	15	235
Total[1]	188	156	99	43	26	512

[1] Totals may be off because of rounding.

[2] High site = 165 cubic feet per acre per year; medium site = 85 to 164 cubic feet per acre per year; low site = 20 to 84 cubic feet per acre per year.

Table 11--*Area of commercial forest land outside National Forests by stockability limitation class, slope percent, and cubic-foot site class, San Joaquin resource area, California, January 1, 1973*

Slope	Site class	Stockability limitation--percent of normal									
		80 to 100 (no problem)		60 to 80 (moderate problem)		40 to 60 (serious problem)		Less than 40 (extreme problem)		Total	
Percent	Cubic feet	Thousand acres	Percent of area	Thousand acres	Percent of area	Thousand acres	Percent of area	Thousand acres	Percent of area	Thousand acres	Percent of area
0 to 45 (flat to gentle)	85+	218	42.7	22	4.3	3	.5	--	--	243	47.5
	<85	54	10.6	30	5.8	85	16.7	17	3.4	186	36.5
46 to 65 (steep)	85+	31	6.1	--	--	--	--	--	--	31	6.1
	<85	6	1.2	15	2.9	17	3.4	--	--	38	7.4
66+ (very steep)	85+	3	.5	--	--	--	--	--	--	3	.5
	<85	3	.5	3	.5	5	1.0	--	--	11	2.0
All slopes	85+	252	--	22	--	3	--	--	--	277	--
	<85	63	--	48	--	107	--	17	--	235	--
Total		315	62	70	14	110	21	17	3	512	100.0

Table 12--*Area of commercial forest land outside National Forests, by forest type, San Joaquin resource area, California, January 1, 1973*

(In thousand acres)

Forest type	All ownerships
Douglas-fir	9
White fir	63
California red fir	1
Ponderosa pine	169
Jeffrey pine	40
Sugar pine	11
Lodgepole pine	5
Giant sequoia	2
Incense-cedar	90
California black oak	56
California white oak and madrone	13
Other hardwoods[1/]	44
Nonstocked	9
All types	512

[1/] Primarily canyon live oak, white alder, and bigleaf maple.

Table 13--*Area of productive reserved forest land by forest type and ownership, San Joaquin resource area, California, January 1, 1973*

(In thousand acres)

Forest type	National Forest	National, State, and county parks	Total
Douglas-fir	--	82	82
White and California red firs	31	191	222
Ponderosa and Jeffrey pines	6	161	167
Sugar pine	--	53	53
Lodgepole pine	[1]	96	96
Giant sequoia	--	7	7
Other conifers[2]	2	6	8
California black oak	--	14	14
Other hardwoods[3]	--	5	5
Total	39	615	654

[1] Less than 500 acres.

[2] 6,000 acres of western white pine, 1,000 acres of mountain hemlock, and 1,000 acres of incense-cedar.

[3] 1,000 acres of white alder, 3,000 acres of aspen, 1,000 acres of cottonwood, and less than 500 acres of California laurel.

Table 14--*Area of unproductive forest land in National Forests; in National, State, and county parks; in other public ownership outside parks; and in private ownership, by type or category, San Joaquin resource area, California, January 1, 1973*

(In thousand acres)

Type or category	National Forests[1]		National, State, and county parks	Other public outside parks	Private	Total
	In wilderness	Not in wilderness				
Rocky	--	--	355	--	13	368
Low site	--	--	--	6	42	48
Pinyon-juniper	--	121	40	101	30	292
Oak[2]	--	--	36	253	1,549	1,838
Chaparral	--	--	82	152	278	512
Type unspecified	288	692	--	--	--	980
Total	288	813	513	512	1,912	4,038

[1] These figures do not include 1,586,000 acres of unproductive forest land and nonforest land on National Forests.

[2] Primarily blue oak, canyon live oak, interior live oak, and California white oak.

Table 15--*Area of commercial forest land; and net volume, net annual growth, and average annual mortality of growing stock and sawtimber outside National Forests, by stand age class, San Joaquin resource area, California, January 1, 1973*

Stand age class	Area	Net volume		Net annual growth		Average annual mortality	
		Growing stock	Sawtimber	Growing stock	Sawtimber	Growing stock	Sawtimber
Years	Thousand acres	Million cubic feet	Million board feet[1]	Thousand cubic feet	Thousand board feet[1]	Thousand cubic feet	Thousand board feet[1]
Nonstocked:	9	[2]	2	5	19	--	--
0-9	26	19	100	446	2,424	111	720
10-19	--	--	--	--	--	--	--
20-29	2	--	--	--	--	--	--
30-39	11	5	24	296	1,359	--	--
40-49	10	28	98	1,210	4,322	21	--
50-59	22	47	218	2,165	12,459	132	486
60-69	14	34	164	1,268	7,103	12	--
70-79	36	122	671	2,792	20,575	797	2,753
80-89	17	67	399	1,124	8,344	724	4,252
90-99	33	54	284	1,644	10,484	123	551
100-119	4	35	240	-14	96	654	4,657
120-139	--	--	--	--	--	--	--
140-159	--	--	--	--	--	--	--
160-179	4	3	18	92	622	--	--
180-199	--	--	--	--	--	--	--
200 and over	2	42	227	156	677	--	--
Uneven-aged:							
0-49	83	131	664	4,092	18,004	253	1,196
50-99	147	481	2,649	9,490	55,772	1,692	9,544
100+	91	372	2,266	4,159	33,158	1,409	8,425
All classes[3]	512	1,441	8,024	28,923	175,418	5,929	32,582

[1] International 1/4-inch rule.

[2] Less than 500,000 cubic feet.

[3] Totals may be off because of rounding.

Table 16--*Net volume of growing stock and sawtimber on commercial forest land and average volume per acre, by ownership and softwoods and hardwoods, San Joaquin resource area, California, January 1, 1973*

Ownership class	Average volume per acre	Softwoods	Hardwoods	All species
	Cubic feet	- - - - -	Million cubic feet	- - - - -
Growing stock:[1]				
National Forest	3,942	6,592	240	6,832
Other public	3,000	113	16	129
Private	2,799	1,199	114	1,313
Total	3,685	7,904	370	8,274
	Board feet	- - - - -	Million board feet	- - - - -
Sawtimber (International 1/4-inch rule):[2] [3]				
Other public	15,581	636	34	670
Private	15,678	7,071	282	7,353
Total	15,670	7,707	316	8,023
Sawtimber (Scribner rule):[4]				
National Forest	23,406	39,487	1,075	40,562
Other public	14,070	572	33	605
Private	13,200	5,913	278	6,191
Total	21,094	45,972	1,386	47,357

[1] Includes trees 5.0 inches in d.b.h. and larger.

[2] Includes softwood trees 9.0 inches in d.b.h. and larger, and hardwood trees 11.0 inches in d.b.h. and larger.

[3] International 1/4-inch volume data not available for all National Forests within the San Joaquin resource area.

[4] Includes trees 11.0 inches in d.b.h. and larger.

Table 17--*Net volume of growing stock and sawtimber on commercial forest land outside National Forests, by forest type, San Joaquin resource area, California, January 1, 1973*

Forest type	Growing stock	Sawtimber	
		International 1/4-inch rule	Scribner rule
	Million cubic feet	- - Million board feet - -	
Douglas-fir	65	464	348
White fir	287	1,794	1,529
California red fir	1	6	5
Ponderosa pine	478	2,598	2,206
Jeffrey pine	72	411	340
Sugar pine	52	319	279
Lodgepole pine	20	107	88
Giant sequoia	42	227	219
Incense-cedar	260	1,361	1,138
California black oak	84	363	322
California white oak	13	69	62
Pacific madrone	5	18	15
Other hardwoods[1]	61	283	245
Nonstocked	[2]	[3]	[3]
All types[4]	1,441	8,024	6,796

[1] Primarily canyon live oak, white alder, and bigleaf maple.

[2] Less than 500,000 cubic feet.

[3] Less than 500,000 board feet.

[4] Totals may be off because of rounding.

Table 18--*Net volume of growing stock and sawtimber on commerical forest land outside National Forests by county and ownership, San Joaquin resource area, California, January 1, 1973*

County	Other public	Private	Total[1]
	- - - - -	Million cubic feet	- - - - -
Growing stock:[2]			
Alpine	2	36	38
Amador	1	217	218
Calaveras	16	344	360
Fresno	5	117	122
Kern	2	73	74
Madera	--	33	34
Mariposa	3	103	105
Mono	--	17	17
Tulare	93	48	141
Tuolumne	8	325	331
Total[1]	130	1,313	1,443
	- - - -	Million board feet	- - - -
Sawtimber (International 1/4-inch rule):[3]			
Alpine	11	199	210
Amador	5	1,303	1,308
Calaveras	84	1,944	2,028
Fresno	23	663	686
Kern	10	375	385
Madera	--	175	175
Mariposa	13	538	551
Mono	--	94	94
Tulare	483	259	742
Tuolumne	41	1,803	1,844
Total[1]	670	7,353	8,023
Sawtimber (Scribner rule):[4]			
Alpine	10	163	173
Amador	5	1,067	1,072
Calaveras	73	1,651	1,724
Fresno	21	562	583
Kern	9	321	330
Madera	--	150	150
Mariposa	10	456	466
Mono	--	79	79
Tulare	444	215	659
Tuolumne	34	1,526	1,560
Total[1]	606	6,190	6,796

[1] Totals may be off because of rounding.

[2] Includes trees 5.0 inches in d.b.h. and larger.

[3] Includes softwood trees 9.0 inches in d.b.h. and larger, hardwood trees 11.0 inches in d.b.h. and larger.

[4] Includes trees 11.0 inches in d.b.h. and larger.

Table 19--*Net volume of growing stock and sawtimber on commercial forest land outside National Forests and average volume per acre, by stand-size class and by softwoods and hardwoods, San Joaquin resource area, California, January 1, 1973*

Stand-size class	Average volume per acre	Softwoods	Hardwoods	All species[1]
	Cubic feet	- - - - - Million cubic feet - - - - -		
Growing stock:[2]				
Large sawtimber stands	3,802	707	42	749
Small sawtimber stands	2,668	576	82	659
Poletimber stands	556	2	3	5
Sapling and seedling stands	580	27	2	29
Nonstocked areas	--	[3]	[3]	[3]
Total[1]	2,814	1,312	130	1,441
	Board feet	- - - - - Million board feet - - - - -		
Sawtimber (International 1/4-inch rule):[4]				
Large sawtimber stands	23,503	4,514	116	4,630
Small sawtimber stands	13,126	3,050	192	3,242
Poletimber stands	1,222	8	3	11
Sapling and seedling stands	2,780	134	5	139
Nonstocked areas	222	1	1	2
Total[1]	15,672	7,707	317	8,024
Sawtimber (Scribner rule):[5]				
Large sawtimber stands	20,599	3,944	114	4,058
Small sawtimber stands	10,595	2,429	188	2,617
Poletimber stands	1,000	7	3	9
Sapling and seedling stands	2,200	105	5	110
Nonstocked areas	222	1	1	2
Total[1]	13,273	6,485	311	6,796

[1] Totals may be off because of rounding.

[2] Includes trees 5.0 inches in d.b.h. and larger.

[3] Less than 500,000 cubic feet.

[4] Includes softwood trees 9.0 inches in d.b.h. and larger, and hardwood trees 11.0 inches in d.b.h. and larger.

[5] Includes trees 11.0 inches in d.b.h. and larger.

Table 20--*Net volume of growing stock on commercial forest land outside National Forests, by species and ownership, San Joaquin resource area, California, January 1, 1973*

(In million cubic feet)

Species	Other public	Private	Total[1]
Softwoods:			
Douglas-fir	1	68	69
White fir	17	257	274
California red fir	--	28	28
Ponderosa pine	26	471	497
Jeffrey pine	2	83	85
Sugar pine	17	113	130
Lodgepole pine[2]	--	20	20
Giant sequoia	38	--	38
Incense-cedar	12	159	171
Total softwoods[1]	113	1,199	1,312
Hardwoods:			
White alder[3]	--	10	10
Black oak	15	77	92
Other hardwoods[4]	1	24	25
Total hardwoods[1]	16	114	130
All species[1]	129	1,312	1,441

[1] Totals may be off because of rounding.

[2] Includes 2 million cubic feet of eastern white pine and mountain hemlock.

[3] Includes bigleaf maple, cottonwood, and aspen.

[4] Includes canyon live oak, interior live oak, California white oak, and madrone.

Table 21--*Net volume of sawtimber on commercial forest land outside National Forests, by species and ownership, San Joaquin resource area, California, January 1, 1973 (International 1/4-inch rule)*

(In million board feet)

Species	Other public	Private	Total[1]
Softwoods:			
Douglas-fir	5	468	473
White fir	102	1,687	1,789
California red fir	--	174	174
Ponderosa pine	152	2,712	2,864
Jeffrey pine	11	495	506
Sugar pine	109	684	793
Lodgepole pine[2]	--	95	95
Giant sequoia	196	--	196
Incense-cedar	61	755	816
Total softwoods[1]	636	7,071	7,707
Hardwoods:			
White alder[3]	--	28	28
Black oak	31	203	234
Other hardwoods[4]	2	53	55
Total hardwoods[1]	34	284	317
All species[1]	670	7,354	8,024

[1] Totals may be off because of rounding.

[2] Includes 2 million board feet of eastern white pine and mountain hemlock.

[3] Includes bigleaf maple, cottonwood, and aspen.

[4] Includes canyon live oak, interior live oak, California white oak, and madrone.

Table 22--*Net volume of sawtimber on commercial forest land outside National Forests, by species and ownership, San Joaquin resource area, California, January 1, 1973 (Scribner rule)*

(In million board feet)

Species	Other public	Private	Total[1]
Softwoods:			
Douglas-fir	4	341	345
White fir	86	1,420	1,506
California red fir	--	154	154
Ponderosa pine	132	2,321	2,453
Jeffrey pine	10	419	429
Sugar pine	100	601	701
Lodgepole pine[2]	--	74	74
Giant sequoia	192	--	192
Incense-cedar	50	581	631
Total softwoods[1]	572	5,913	6,485
Hardwoods:			
White alder[3]	--	28	28
Black oak	31	199	230
Other hardwoods[4]	2	51	53
Total hardwoods[1]	33	278	311
All species[1]	605	6,191	6,796

[1] Totals may be off because of rounding.

[2] Includes 2 million board feet of eastern white pine and mountain hemlock.

[3] Includes bigleaf maple, cottonwood, and aspen.

[4] Includes canyon live oak, interior live oak, California white oak, and madrone.

Table 23--*Net volume of growing stock on commercial forest land outside National Forests, by species and diameter class, San Joaquin resource area, California, January 1, 1973*

(In million cubic feet)

Species	Diameter class (inches at breast height)											
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger	All classes[1]
Softwoods:												
Douglas-fir	2	1	4	4	5	5	7	3	17	6	15	69
White fir	4	7	9	16	11	21	20	21	92	56	16	274
California red fir	--	--	--	1	1	--	--	1	9	5	11	28
Ponderosa pine	9	12	16	29	32	36	27	48	136	78	65	497
Jeffrey pine	--	1	2	3	4	6	6	5	37	19	12	85
Sugar pine	2	2	2	5	5	4	6	6	26	27	45	130
Lodgepole pine[2]	--	1	2	2	2	2	2	3	4	2	--	20
Giant sequoia	--	--	--	--	--	--	--	--	1	1	37	38
Incense-cedar	8	11	10	11	11	10	12	8	34	33	23	171
Total softwoods[1]	24	36	45	71	72	84	90	94	345	227	224	1,312
Hardwoods:												
White alder[3]	--	1	2	2	2	1	1	1	--	1	--	11
Black oak	2	4	6	7	8	8	11	5	27	12	3	92
Other hardwoods[4]	2	3	2	3	3	3	3	1	5	2	--	27
Total hardwoods[1]	4	8	9	12	13	12	15	7	32	15	3	130
All species[1]	29	44	54	83	85	97	104	101	377	242	227	1,441

[1] Totals may be off because of rounding.

[2] Includes 2 million cubic feet of western white pine and mountain hemlock.

[3] Includes bigleaf maple, cottonwood, and aspen.

[4] Includes canyon live oak, interior live oak, California white oak, and madrone.

Table 24--*Net volume of sawtimber on commercial forest land outside National Forests, by species and diameter class, San Joaquin resource area, California, January 1, 1973 (International 1/4-inch rule)*

(In million board feet)

Species	Diameter class (inches at breast height)									
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger	All classes[1]
Softwoods:										
Douglas-fir	16	23	31	32	41	21	102	36	171	473
White fir	37	77	63	132	133	141	667	420	119	1,789
California red fir	1	5	5	1	--	6	51	32	73	174
Ponderosa pine	46	116	150	185	196	282	865	537	475	2,864
Jeffrey pine	5	11	20	32	30	27	163	128	89	506
Sugar pine	6	22	25	18	33	34	159	178	318	793
Lodgepole pine[2]	8	7	9	10	9	13	25	13	1	95
Giant sequoia	--	--	--	--	--	--	2	3	192	196
Incense-cedar	40	48	51	49	63	41	190	195	139	816
Total softwoods[1]	158	309	355	460	517	564	2,224	1,543	1,576	7,707
Hardwoods:										
White alder[3]	--	4	6	5	3	4	2	4	--	28
Black oak	--	13	16	19	28	14	84	45	14	234
Other hardwoods[4]	--	7	6	7	8	4	14	8	1	55
Total hardwoods[1]	--	24	29	31	38	22	99	58	16	317
All species[1]	158	333	384	491	556	586	2,323	1,601	1,592	8,024

[1] Totals may be off because of rounding.

[2] Includes 4 million board feet of western white pine and 2 million board feet of mountain hemlock.

[3] Includes bigleaf maple and cottonwood.

[4] Includes canyon live oak, California white oak, and madrone.

Table 25--*Net volume of sawtimber on commercial forest land outside National Forests, by species and diameter class, San Joaquin resource area, California, January 1, 1973 (Scribner rule)*

(In million board feet)

Species	Diameter class (inches at breast height)								
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger	All classes[1]
Softwoods:										
Douglas-fir	--	18	23	25	33	17	89	33	107	345
White fir	--	57	49	105	108	118	577	380	113	1,506
California red fir	--	2	4	1	--	5	45	29	69	154
Ponderosa pine	--	60	105	145	174	244	781	499	444	2,453
Jeffrey pine	--	3	11	22	23	22	144	120	85	429
Sugar pine	--	12	18	14	26	29	138	163	301	701
Lodgepole pine[2]	--	5	7	9	8	10	22	12	1	74
Giant sequoia	--	--	--	--	--	--	2	2	187	192
Incense-cedar	--	28	34	35	48	33	159	173	122	631
Total softwoods[1]	--	184	251	356	420	478	1,957	1,410	1,429	6,485
Hardwoods:										
White alder[3]	--	4	6	5	3	4	1	4	1	28
Black oak	--	12	16	19	28	14	83	45	14	230
Other hardwoods[4]	--	7	6	6	8	4	14	8	1	53
Total hardwoods[1]	--	23	28	30	38	21	98	57	16	311
All species[1]	--	207	279	386	458	499	2,055	1,467	1,445	6,796

[1] Totals may be off because of rounding.

[2] Includes 2 million board feet of western white pine and 1 million board feet of mountain hemlock.

[3] Includes bigleaf maple and cottonwood.

[4] Includes canyon live oak, California white oak, and madrone.

Table 26--*Volume of timber on commercial forest land outside National Forests, by class of timber and by softwoods and hardwoods, San Joaquin resource area, California, January 1, 1973*

(In million cubic feet)

Class of timber	Softwoods	Hardwoods	All species
Sawtimber trees:			
Saw-log portion	1,206	57	1,263
Upper-stem portion	45	51	96
Total	1,251	108	1,359
Poletimber trees	60	21	81
All growing-stock trees	1,311	129	1,440
Sound cull trees	7	22	29
Rotten cull trees	1	14	15
Salvable dead trees	20	[1]	20
All timber	1,339	165	1,504

[1] Less than 500,000 cubic feet.

Table 27--*Number of growing-stock trees on commercial forest land outside National Forests, by species and diameter class, San Joaquin resource area, California, January 1, 1973*

(In thousand trees)

Species	Diameter class (inches at breast height)												
	1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger	All classes[1]
Softwoods:														
Douglas-fir	1,325	640	733	211	281	167	160	109	105	36	131	22	15	3,935
White fir	7,061	4,390	1,989	1,719	1,223	1,180	536	672	475	357	873	277	37	20,789
California red fir	735	160	--	75	35	75	48	9	--	21	74	23	15	1,270
Ponderosa pine	6,940	3,398	4,020	2,532	1,751	1,720	1,189	917	672	638	1,095	273	100	25,246
Jeffrey pine	218	143	133	235	302	254	246	239	173	95	321	92	22	2,474
Sugar pine	2,192	1,696	970	501	219	342	205	100	120	91	230	108	63	6,837
Western white pine	32	16	--	18	32	16	6	5	3	5	--	--	--	134
Lodgepole pine	107	164	91	135	185	97	98	65	46	29	45	12	--	1,076
Mountain hemlock	--	--	--	20	27	8	--	--	--	3	--	--	--	58
Giant sequoia	--	73	--	--	32	--	--	--	--	--	7	4	9	125
Incense-cedar	21,466	9,277	4,576	2,904	1,390	1,029	637	433	338	189	487	237	85	43,048
Total softwoods[1]	40,078	19,957	12,512	8,351	5,476	4,887	3,126	2,550	1,933	1,463	3,263	1,048	346	104,992
Hardwoods:														
White alder[2]	859	282	222	162	161	107	88	42	21	18	3	4	--	1,968
Black oak	1,818	1,611	947	1,066	761	572	426	323	338	120	396	95	11	8,485
Other hardwoods[3]	7,122	3,192	740	674	245	299	162	118	86	29	73	20	2	12,762
Total hardwoods[1]	9,800	5,085	1,909	1,902	1,167	978	676	483	445	167	472	119	13	23,215
All species[1]	49,878	25,042	14,241	10,253	6,643	5,865	3,802	3,033	2,378	1,630	3,735	1,167	359	128,205

[1] Totals may be off because of rounding.

[2] Includes bigleaf maple, cottonwood, and aspen.

[3] Includes canyon live oak, interior live oak, California white oak, and madrone.

Table 28--*Net annual growth of growing stock on commercial forest land, by ownership class, San Joaquin resource area, California, 1972*

Ownership	Growth per acre	Growing stock		
		Softwoods	Hardwoods	All species
	Cubic feet	- - - - Thousand cubic feet - - - -		
National Forests	41.7	72,100	200	72,300
Other public	40.1	1,518	208	1,726
Private	58.1	25,641	1,556	27,197
All ownerships	45.1	99,259	1,964	101,223

Table 29--*Net annual growth of growing stock and sawtimber on commercial forest land outside National Forests by species, San Joaquin resource area, California, January 1, 1973*

Species	Growing stock	Sawtimber	
		International 1/4-inch rule	Scribner rule
	Thousand cubic feet	- - - - - Thousand board feet - - - - -	
Softwoods:			
Douglas-fir[1]	1,152	7,535	9,312
White fir[1]	5,015	37,013	42,613
California red fir	123	699	588
Ponderosa pine	12,549	78,789	69,437
Jeffrey pine	1,522	9,701	8,872
Sugar pine	3,658	22,128	20,151
Lodgepole pine[2]	364	2,120	1,448
Giant sequoia	248	1,202	1,188
Incense-cedar	2,528	11,538	9,672
Total softwoods[3]	27,159	170,726	163,280
Hardwoods:			
White alder[4]	177	825	816
Black oak	1,069	3,058	3,024
Other hardwoods[5]	518	808	796
Total hardwoods[3]	1,764	4,691	4,635
All species[3]	28,923	175,418	167,915

---

[1] Net annual growth in International 1/4-inch board feet is less than Scribner for these species because of relatively high mortality in trees 9.0 to 10.9 inches in size.

[2] Includes western white pine and mountain hemlock.

[3] Totals may be off because of rounding.

[4] Includes bigleaf maple, cottonwood, and aspen.

[5] Includes canyon live oak, interior live oak, California white oak, and madrone.

Table 30--*Net annual growth of growing stock and sawtimber on commercial forest land outside National Forests, by forest types, San Joaquin resource area, California, January 1, 1973*

Forest type	Growing stock	Sawtimber	
		International 1/4-inch rule	Scribner rule
	Thousand cubic feet	- - - - - Thousand board feet - - - - -	
Douglas-fir	474	4,277	6,924
White fir	4,907	30,293	37,370
California red fir	43	256	223
Ponderosa pine	12,122	72,352	61,236
Jeffrey pine	1,609	10,358	9,453
Sugar pine	1,132	8,717	6,792
Lodgepole pine	295	1,596	1,095
Giant sequoia	156	677	673
Incense-cedar	5,290	31,415	27,367
California black oak	1,104	6,302	5,971
California white oak	444	2,368	2,213
Madrone	71	106	104
Other hardwoods	1,273	6,684	8,474
Nonstocked	5	19	19
All types[1]	28,923	175,418	167,915

[1] Totals may be off because of rounding.

Table 31--*Average annual mortality of growing stock and sawtimber on commercial forest land outside National Forests, by species, San Joaquin resource area, California*

Species	Growing stock	Sawtimber	
		International 1/4-inch rule	Scribner rule
	Thousand cubic feet	- - - - - Thousand board feet - - - - -	
Softwoods:			
Douglas-fir	106	374	--
White fir	2,034	12,044	9,469
California red fir	165	1,048	946
Ponderosa pine	1,842	9,486	7,710
Jeffrey pine	234	1,706	1,599
Sugar pine	105	143	75
Lodgepole pine	28	191	172
Incense-cedar	1,344	7,511	5,828
Total	5,859	32,504	25,799
All hardwoods	70	78	76
All species[1]	5,929	32,582	25,875

[1] Totals may be off because of rounding.

Table 32--Reported timber production by county, San Joaquin resource area, and all of California, 1947-75

(In thousand board feet)[1]

Year	Alpine	Amador	Calaveras	Fresno	Kern	Kings[2]	Madera	Merced	Mariposa	Mono	Tulare	Toulumne	Resource area total[3]	All of California
1947	640	57,893	149,987	37,253	1,930		21,373	[2]	17,828	7,602	52,216	152,973	499,695	3,185,995
1948	495	14,826	155,884	40,755	600		18,628	[2]	22,386	6,290	64,657	164,840	489,361	3,983,213
1949	765	8,961	139,218	42,865	2,950		10,288	[2]	18,370	14,586	46,918	142,976	427,897	3,795,252
1950	[4]	16,409	185,819	42,852	4,800		40,451	[2]	5,185	14,144	98,604	162,689	571,043	4,303,011
1951	[4]	42,114	155,584	32,011	1,650		38,967	[2]	16,736	800	57,545	173,824	519,231	4,984,288
1952	6,784	22,805	108,157	62,761	2,120		39,208	[2]	12,068	15,250	53,428	143,626	466,207	5,057,036
1953	9,925	16,161	150,262	66,893	[5]		41,861	[2]	14,830	14,798	[5] 41,792	164,829	521,351	5,990,088
1954	[4]	23,474	128,195	64,976	[5]		26,095	[2]	15,055	[4] 22,563	[5] 35,414	117,075	432,847	5,600,310
1955	[4]	34,275	112,977	67,606	[5]		56,153	[6]	[6] 8,519	[4] 7,536	[5] 54,560	155,128	496,754	6,014,939
1956	[4]	35,552	125,183	86,304	[5]		72,768	[6]	[6] 13,725	[4] 23,055	[5] 48,740	132,135	537,462	5,861,634
1957	[4]	34,759	107,589	58,768	[5]		45,424	[6]	[6] 14,101	[4] 43,589	[5] 28,416	148,032	480,678	5,346,521
1958	[4]	39,088	98,925	68,326	[5]		61,964	[6]	[6] 5,558	[4] 28,024	[5] 39,041	114,203	455,129	5,675,392
1959	[4]	12,680	116,249	60,166	[5]		74,746	[6]	[6] 15,254	[4] 27,967	[5] 51,821	134,856	493,739	5,886,061
1960	[4]	16,178	74,188	52,534	[5]		64,020	[6]	[6] 18,593	[4] 16,676	[5] 39,968	74,186	356,343	5,136,649
1961	[4]	60,668	105,790	40,765	[5]		61,436	[6]	[6] 1,378	[4] 13,300	[5] 42,680	133,755	459,772	5,342,250
1962	[4]	43,786	73,563	74,989	[5]		59,724	[6]	[6] 6,504	[4] 11,607	[5] 63,707	26,988	360,868	5,538,928
1963	[4]	21,681	97,600	48,660	[5]		55,683	[6]	[6] 4,481	[4] 25,210	[5] 84,965	122,801	461,081	5,461,046
1964	[4]	36,076	54,627	74,017	[5]		62,630	[6]	[6] 19,853	[4] 8,098	[5] 88,000	110,146	453,447	5,476,265
1965	[4]	40,814	75,099	76,251	[5]		52,982	[6]	[6] 8,406	[4] 4,202	[5] 69,955	145,595	473,304	5,271,234
1966	[4]	11,462	50,581	87,980	[5]		70,312	[6]	[6] 10,506	[4] 4,019	[5] 70,922	191,725	497,507	5,008,318
1967	[4]	35,203	60,162	84,011	[5]		68,589	[6]	[6] 8,745	[4] 3,004	[5] 83,013	178,816	521,543	5,062,021
1968	[4]	25,405	85,137	104,256	[5]		60,898	[6]	[6] 1,188	[4] 15,630	[5] 98,025	189,012	579,551	5,343,898
1969	[4]	26,856	45,020	137,242	[5]		63,923	[6]	[6] 17,283	[4] 11,857	[5] 89,616	157,795	549,556	5,000,596
1970	[4]	12,849	72,016	109,840	[5]		77,043	[6]	[6] 11,004	[4] 9,210	[5] 79,192	153,861	525,015	4,565,827
1971	[4]	29,891	55,731	86,944	[5]		74,545	[6]	[6] 10,578	[4] 8,034	[5] 149,823	160,168	575,714	4,789,617
1972	[4]	38,893	47,767	88,520	[5]		82,009	[6]	[6] 7,782	[4] 25,284	[5] 155,211	150,666	596,132	5,000,507
1973	[4]	36,761	51,743	99,831	[5]		69,598	[6]	[6] 8,757	[4] 14,819	[5] 123,247	145,190	549,946	4,923,000
1974	[4]	35,043	21,071	121,284	[5]		58,882	[6]	[6] 1,606	[4] 5,620	[5] 77,637	165,966	487,109	4,703,614
1975	[4]	40,232	35,977	136,304	[5]		64,289	[6]	[6] 15,977	[4] 2,212	[5] 82,657	120,722	498,370	4,334,423

[1] Source: "Production of California Timber Operators," State Forest Notes published annually by California Division of Forestry. Various log rules are used in California; no attempt was made to convert the data to a common base; however, the majority of the timber industry companies in the San Joaquin resource area used the short-log Scribner rule.

[2] No reported production (county mostly nonforest).

[3] San Joaquin and Stanislau counties are mostly nonforest. No timber production was reported from these counties.

[4] Alpine, Mono, and Inyo were combined.

[5] Kern, Tulare, and Ventura were combined.

[6] Mariposa and Merced were combined.

Table 33--*Confidence intervals for the estimates of forest area and timber volume outside National Forests, San Joaquin resource area, California, January 1, 1973*

Item	Estimated total	Confidence interval	
		68-percent probability	95-percent probability
		- - - - Percent - - - -	
Commercial forest land	512,000 acres	±3.7	±7.2
Noncommercial forest land	2,424,000 acres[1]	±1.8	±3.5
Volume:			
Growing stock	1,441 million cubic feet	±5.8	±11.4
Sawtimber (International 1/4-inch rule)	8,024 million board feet	±6.8	±13.3

[1] Includes only the forest area outside parks and other reservations, determined by sampling methods. Forest area within parks and other reservations was determined by type-mapping procedures not subject to sampling error.

Table 34--*Approximate confidence interval by size of estimate, outside National Forests, San Joaquin resource area, California, January 1, 1973*

Commercial forest land		Noncommercial forest land		Growing stock		Sawtimber	
Area	Confidence interval[1] (+ or -)	Area	Confidence interval[1] (+ or -)	Volume	Confidence interval[1] (+ or -)	Volume	Confidence interval[1] (+ or -)
Thousand acres	Percent	Thousand acres	Percent	Million cubic feet	Percent	Million board feet[2]	Percent
512	3.7	2,424	1.8	1,441	5.8	8,024	6.8
250	5.3	1,500	2.3	750	8.0	6,000	7.8
125	7.5	1,000	2.8	500	9.8	4,000	9.6
100	8.3	500	4.0	250	13.8	2,000	13.5
75	9.6	250	5.7	225	14.6	1,000	19.2
50	11.8	125	8.0	175	16.5	750	22.1
25	16.7	100	9.0	150	17.9	500	27.1
10	26.4	75	10.3	125	19.6	250	38.3
5	37.3	50	12.7	100	21.9	225	40.4
		25	17.9	75	25.3	200	42.8
		10	28.3	50	31.0	175	49.4
		5	40.1	25	43.8	150	49.4
				10	69.3	125	54.2
						100	60.6
						75	69.9
						50	85.6
						25	121.1
						10	191.5

[1] By random sampling formula: 68-percent probability.

[2] International 1/4-inch rule.

REFERENCES

Barrette, B. R., D. R. Gedney, and D. D. Oswald.
1970. California timber industries, 1968, mill characteristics and wood supply. Calif. Dep. Conserv. Div. For. 117 p. Sacramento, Calif.

Burks, George F., H. J. Vaux, R. H. May, and A. Simontacchi.
1948. Commodity production from commercial forest land in California, 1946. USDA For. Serv. Calif. For. and Range Exp. Stn. For. Surv. Release 6, 38 p. Berkeley, Calif.

California Department of Fish and Game.
1966. California fish and wildlife plan. 5 vols. Sacramento, Calif.

California Department of Water Resources.
1972. Dams within jurisdiction of the State of California. Dep. Water Resour. Bull 17-71, 66 p. Sacramento, Calif.

California Department of Water Resources.
1974. The California water plan, outlook in 1974. Bull. No. 160-74, 186 p. Sacramento, Calif.

California Division of Forestry.
1947-75. Production of California timber operators. State For. Notes. (Annu. publ.) Sacramento, Calif.

California Division of Forestry.
1953-74. California wildfire statistics - annual reports. Sacramento, Calif.

California Division of Forestry.
1961-74. Brushland range improvement annual reports. Sacramento, Calif.

California Division of Forestry.
1968. California forest practices rules - California administrative code, title 14, div. 2, ch. 2. Sacramento, Calif.

California Division of Forestry.
1969. Soil-vegetation surveys in California. State coop. Calif. Div. For., USDA For. Serv. Pac. Southwest For. and Range Exp. Stn., Univ. Calif., Agric. Exp. Stn., Sacramento, Calif.

Dahms, Walter G.
1964. Gross and net yield tables for lodgepole pine. USDA For. Serv. Res. Pap. PNW-8, 14 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Dunning, Duncan, and L. H. Reineke.
1933. Preliminary yield tables for second-growth stands in the California pine region. U.S. Dep. Agric. Tech. Bull. No. 354, 23 p. Washington, D.C.

Fowells, H. A., and N. B. Stark.
1965. Natural regeneration in relation to environment in the mixed conifer type of California. USDA For. Serv. Res. Pap. PSW-24. Pac. Southwest For. and Range Exp. Stn., Berkeley, Calif.

Griffin, James R.
1967. Soil moisture and vegetation patterns in northern California forests. USDA For. Serv. Res. Pap. PSW-46, 22 p. Pac. Southwest For. and Range Exp. Stn., Berkeley, Calif.

Griffin, James R., and William B. Critchfield.
1972. The distribution of forest trees in California. USDA For. Serv. Res. Pap. PSW-82, 114 p. Pac. Southwest For. and Range Exp. Stn., Berkeley, Calif.

Howard, James O.
1974. California forest industry--wood consumption characteristics, 1972. USDA For. Serv. Resour. Bull. PNW-52, 91 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Little, Elbert L., Jr.
1953. Check list of native and naturalized trees of the United States (including Alaska). U.S. Dep. Agric. Agric. Handb. 41, 472 p.

McArdle, Richard E., W. H. Meyer, and D. Bruce.
1961. The yield of Douglas-fir in the Pacific Northwest. U.S. Dep. Agric. Tech. Bull. 201 (rev.), 74 p., illus.

McDonald, Philip M.
1973. Cutting a young-growth mixed-conifer stand to California Forest Practice Act standards. USDA For. Serv. Res. Pap. PSW-89, 16 p. Berkeley, Calif.

MacLean, Colin D., and Charles L. Bolsinger.
1973a. Estimating Dunning's site index from plant indicators. USDA For. Serv. Res. Note PNW-197, 10 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

MacLean, Colin D., and Charles L. Bolsinger.
1973b. Estimating productivity on sites with a low stocking capacity. USDA For. Serv. Res. Pap. PNW-152, 18 p. Pac. Northwest For. Range Exp. Stn., Portland, Oreg.

MacLean, Colin D., and Charles L. Bolsinger.
1974. Stockability equations for California forest land. USDA For. Serv. Res. Note PNW-233, 10 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

May, Richard H., and Harold Baker.
1958. Output of timber products in California, 1956. USDA For. Serv. Calif. For. and Range Exp. Stn. For. Surv. Release 35, 35 p. Berkeley, Calif.

Meyer, Walter H.
1961. Yield of even-aged stands of ponderosa pine. U.S. Dep. Agric. Tech. Bull. 630, 59 p.

Muerle, G. F., and E. M. Hornibrook.
1965. Timber harvest in California, 1962. USDA For. Serv. Resour. Bull. PSW-2, 29 p. Pac. Southwest For. and Range Exp. Stn., Berkeley, Calif.

Munz, Philip A., and David D. Keck.
1970. A California flora. 1,681 p. Univ. Calif. Press, Berkeley.

Oswald, Daniel D.
1970. California forest industries--prospects for the future. USDA For. Serv. Resour. Bull. PNW-35, 55 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Oswald, Daniel D., and E. M. Hornibrook.
1966. Commercial forest area and timber volume in California, 1963. USDA For. Serv. Resour. Bull. PSW-4, 16 p. Pac. Southwest For. and Range Exp. Stn., Berkeley, Calif.

Schumacher, Francis X.
1926. Yield, stand and volume tables for white fir in the California pine region. Calif. Agric. Exp. Stn. Bull. No. 407, 26 p., illus. Univ. Calif., Berkeley.

Schumacher, Francis X.
1930. Yield, stand and volume tables for Douglas-fir in California. Calif. Agric. Exp. Stn. Bull. No. 491, 41 p., illus. Univ. Calif., Berkeley.

State of California.
1974. California administrative code, title 14, div. 2, ch. 2; art. 4, div. 4, ch. 8. Public Resour. Code.

State of California.
1976. Assembly bill No. 1258. Sacramento, Calif.

State of California, Documents Section.
1975. California statistical abstract. 146 p. Sacramento, Calif.

U.S. Department of Agriculture, Forest Service.
1953-73. Timber cut and sold on National Forests - report 1380 (2400). Reg. 4, Ogden, Utah; Reg. 5, San Francisco, Calif.

U.S. Department of Agriculture, Forest Service.
1954. Forest statistics for California. USDA For. Serv. Calif. For. and Range Exp. Stn. For. Surv. Release 25, 66 p. Berkeley, Calif.

U.S. Department of Agriculture, Forest Service.
1965. Silvics of forest trees of the United States. U.S. Dep. Agric. Agric. Handb. No. 271, 762 p. Washington, D.C.

U.S. Department of Agriculture, Forest Service.
1972. Forest Service manual, title 2400 - Timber management - section 2412 Land classification. Washington, D.C.

U.S. Department of Agriculture, Forest Service.
1976. Land use classification, timber land use summary and annual potential yield statement, reports 24.21, 24.21A, 24.21B, 24.21C, and 24.22A, Region 5. San Francisco, Calif.

U.S. Office of Management and Budget.
1972. Standard industrial classification manual, 1972. 649 p.

Waring, R. H., K. L. Reed, and W. H. Emmingham.
1972. An environmental grid for classifying coniferous forest ecosystems. *In* Proceedings--Research on coniferous forest ecosystems--a symposium. Jerry F. Franklin et al., eds. p. 79-91, illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Wieslander, A. E., and Herbert A. Jensen.
1946. Forest areas, timber volumes and vegetation types in California. USDA For. Serv. Calif. For. and Range Exp. Stn. For. Surv. Release 4, 66 p. Berkeley.

APPENDIX

RELIABILITY OF FOREST RESOURCE ESTIMATES

The estimates of forest land area and timber volume outside National Forests in the San Joaquin resource area were derived by sampling and thus have sampling error. Confidence intervals have been computed for the estimate of commercial forest land area, noncommercial forest land area, net cubic-foot volume of growing stock, and net board-foot volume (International 1/4-inch rule) of sawtimber. These confidence intervals are presented in table 33 as a percent of the estimated total at the 68-percent and 95-percent probability levels. They may be interpreted as meaning that the odds are two out of three for 68-percent probability, or 19 out of 20 for 95-percent probability that the ranges shown include the true value (i.e., the results of a 100-percent inventory). For example, we can expect, with 95-percent confidence, that the estimate of commercial forest land area--512,000 acres ± 7.2 percent (36,864 acres)--includes the true value.

In addition to measurable sampling errors, there may be nonsampling errors caused by mistakes in judgment, measurement, and compilation. The magnitude of errors of this nature cannot be determined; however, such errors are kept to a minimum through training, supervision, field checking, editing, and machine verification when the data are compiled.

The reliability of any breakdown of these totals will be substantially less than the sampling error of the total. The smaller the breakdown the larger the confidence interval. An approximation of confidence intervals associated with various breakdown of the totals can be obtained from table 34.

INVENTORY PROCEDURES

The forest statistics for lands outside National Forests were collected in 1972 by Renewable Resources Evaluation personnel of the Pacific Northwest Forest and Range Experiment Station. The procedures used for these lands were designed specifically so that the kinds of data shown in this report could be obtained. The forest statistics for the Toiyabe National Forest of Region 4 were collected in 1975 by Region 4 and Toiyabe National Forest personnel using procedures nearly identical to the ones we used on lands outside National Forests.

For *lands outside National Forests* and for the *Toiyabe National Forest*, a double sampling inventory design was used. Aerial photo sample plots 1 acre in size were distributed systematically across the area and classified into commercial forest, noncommercial forest, and nonforest. Commercial forest plots were further classified into several stand volume classes. In addition, plots outside National Forests were classified by owner from county tax assessor records. A random sample of field plots was selected, proportional to the number of aerial photo plots in each land class, volume class, and ownership class on lands outside National Forests. The field sample was used to adjust the aerial photo sample for photo interpretation errors and changes since the date of photography. It also provided detailed stand data such as stocking by species, volume by size class, etc. Field plots consisted of 10 sample points distributed over an acre. The variable radius plot sampling principle was used to select trees 5.0 inches and larger in d.b.h. to be tallied; trees smaller than 5 inches were tallied on a circular fixed radius plot. Where no trees were tallied, a ground cover class was recorded. Also recorded were indicator plants and other physical variables used to predict stockability and site index where suitable site trees were not present (MacLean and Bolsinger 1973a). Information on past disturbance or treatment and nontimber uses was also recorded. Increment borings were taken from all trees 5.0 inches and larger on 3 of the 10 points for determining the past 10 years' growth. Mortality was estimated over a 5-year period by postdating all dead trees tallied.

The sample on lands outside National Forests consisted of 13,953 aerial photo plots in all land classes, from which were selected 220 commercial forest field plots and 509 noncommercial forest field plots.

The Toiyabe National Forest sample within the San Joaquin resource area consisted of 2,026 aerial photo plots in all land classes, from which were selected 131 commercial forest field plots and 59 noncommercial forest field plots.

Timber inventories for *Region 5 National Forests* were designed specifically to provide data for their timber planning model. They provide statistics on total area, volume, growth, and mortality for entire National Forests but do not provide details for counties within the San Joaquin resource area.

For Region 5, National Forests type maps were made on which commercial, noncommercial, and nonforest land classes were delineated. Commercial forest areas were then further divided into condition classes and major types. Type-mapped areas of noncommercial and nonforest land were accepted without ground checking. For sampling commercial forest area, field plots were distributed proportional to area by condition class and major type. Field plots consisted of five sample points 132 feet apart in an L-shape. At each point the variable radius plot sampling principle was used to select tally trees 1-inch d.b.h. and larger. Trees smaller than 1-inch d.b.h. were tallied on a circular, fixed radius plot. Growth and mortality estimates were developed from 10-year increment borings and 5-year post-dating of dead trees.

The following tabulation shows the total number of plots established on these National Forests and the approximate proportion of commercial forest area within the San Joaquin resource area:

National Forest	Number of plots	Proportion of commercial forest in San Joaquin resource area	Inventory date
Eldorado	102	0.10	1974
Inyo	60	.94	[1]1964
Los Padres	72	.17	1975
Sequoia	141	1.00	[1]1958
Sierra	97	1.00	1975
Stanislaus	118	1.00	1972
	590	.82	

DEFINITION OF TERMS

Land Area

Total land area is that reported by the Bureau of the Census and includes dry land and land temporarily or partially covered by water (such as marshes, swamps, and river flood plains), streams, sloughs, and canals less than 1/8-mile wide, and lakes, reservoirs, and ponds less than 40 acres in size.

Forest land is at least 10 percent stocked by trees of any size or is land that formerly had such tree cover and is not currently developed for nonforest use. Minimum area of forest land recognized is 1 acre.

Nonforest land has never supported forests or was formerly forested and is currently developed for nonforest uses. Included are lands used for agricultural crops, improved pasture, residential areas, city parks, improved roads of any width and their right-of-way clearings, and powerline clearings of any width, and 1- to 40-acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and other nonforest strips must be more than 120 feet wide, and clearings, etc., more than 1 acre in size, to qualify as nonforest land.

---

[1] Recent inventories of these National Forests have not yet been compiled. Statistics shown in this report for these National Forests have been adjusted to account for major changes since the inventory dates shown.

Forest Land Classes

Commercial forest land is capable of producing 20 cubic feet per acre per year of industrial wood and is not withdrawn from timber utilization.

Noncommercial forest land consists of unproductive forest land and productive reserved forest land.

Productive reserved forest land is withdrawn from timber utilization through statute, ordinance, or administrative order but otherwise qualifies as commercial forest land.

Unproductive forest land is incapable of yielding crops of industrial wood products because of adverse site conditions such as sterile soil, poor drainage, high elevation, steepness, and rockiness.

Forest Types

Forest types are determined on the basis of species plurality of all live trees that contribute to stocking; both size and spacing are considered.

Tree Classes

Growing Stock

Sawtimber trees, poletimber trees, saplings, and seedlings are included; that is, all live trees except cull trees.

Sawtimber trees are growing-stock trees and are at least 9.0 inches in d.b.h. if they are softwoods, and at least 11.0 inches in d.b.h. if they are hardwoods. At least 25 percent of the board-foot volume in any sawtimber tree must be free from defect. Softwood trees must contain at least one 12-foot saw log with a top diameter of not less than 6 inches inside the bark. Hardwood trees must contain at least one 8-foot saw log with a top diameter of not less than 8 inches inside the bark.

Poletimber trees are 5.0- to 8.9-inch d.b.h., live, and of commercial species, not less than 25 percent sound on a cubic-foot basis, and have no disease, defects, or deformities likely to prevent them from becoming growing-stock sawtimber trees.

Sapling and seedling trees are less than 5.0-inch d.b.h., live, of commercial species, and have no disease, defects, or deformities likely to prevent them from becoming growing-stock poletimber trees.

Nongrowing Stock

Cull trees are noncommercial species or commercial species which are too defective or are unlikely to become growing-stock trees because of deformity, disease, low vigor, etc.

Sound cull trees are noncommercial species or commercial species with excessive defect because of form, roughness, etc.

Rotten cull trees have excessive defect, primarily from rot.

Mortality trees are commercial species which have died from natural causes within a specified period and which were not cull trees at the time of death.

Salvable dead trees are standing or down trees of commercial species, 11.0 inches or more in diameter; they contain 25 percent or more of sound volume and at least one merchantable 16-foot log for softwoods or one merchantable 8-foot log for hardwoods.

Stand Size Classes

Sawtimber stands are at least 10.0 percent stocked with growing-stock trees; half or more of this stocking is in sawtimber and poletimber trees and sawtimber stocking is equal to or greater than poletimber stocking. In *large sawtimber stands*, the majority of the sawtimber stocking is in trees 21.0 inches and larger at breast height. In *small sawtimber stands*, the majority of the sawtimber stocking is in softwood trees from 9.0- to 20.9-inch d.b.h. and hardwood trees 11.0- to 20.9-inch d.b.h.

Poletimber stands are at least 10.0 percent stocked with growing-stock trees; half or more of this stocking is in sawtimber and poletimber trees, and poletimber stocking exceeds sawtimber stocking.

Sapling and seedling stands are at least 10.0 percent stocked with growing-stock trees; more than half of this stocking is in saplings and seedlings.

Nonstocked areas of commercial forest land are less than 10.0 percent stocked with growing-stock trees.

Stocking

Stocking is a measure of how well the productive potential of the site is utilized by trees. For stands with a mean d.b.h. of at least 8 inches, the measure of stocking used is relative density expressed as a percentage of normal stocking; i.e., the current number of trees per acre expressed as a percentage of the normal number indicated for a stand of the same mean diameter and species. For stands with a mean diameter of less than 8 inches, stocking is not an indication of the current level of site utilization but rather it is an estimation of the degree of site utilization expected when the stand reaches 8 inches in mean diameter. For such stands, the stocking standard is the normal number of trees for an 8-inch stand, discounted for expected mortality. In stands of mixed size and species, the density standard is a weighted average for the various species and sizes of trees present.

In general, stocking standards are based on normal yield tables such as those in USDA Technical Bulletin No. 630 (Meyer 1961). Some sites, however, because of hot dry conditions, serpentine soils, rock outcrops, or other restrictions, are unable to support the density of trees indicated by the normal yield tables. On such areas, stocking standards are adjusted to reflect lower stocking capacity (MacLean and Bolsinger 1973b, 1974).

Full normal stocking (100 percent in this report) requires far more trees than are needed to fully occupy the site. In this study, stands in excess of 60-percent stocking are considered to be fully occupying their sites.

Stockability is the capability of forest land to support a specified number of trees of specified species, age, and size. Normal yield tables define stockability levels for sites with no restrictions on the capability of the land to support trees.

Timber Volume

Live Sawtimber

Net volume of live sawtimber trees of commercial species is measured in board feet. Net volume equals gross volume less deduction for rot, sweep, crook, and other defects that affect use for lumber.

Scribner rule is the common board-foot log rule used locally in determining volume of sawtimber. Scribner volume was computed on a 16-foot log basis to a utilized top for trees 11.0-inch d.b.h. and larger.

International 1/4-inch rule is the standard board-foot log rule adopted nationally by the Forest Service for the presentation of volume statistics. For calculating International 1/4-inch board-foot volume the minimum diameter for softwood trees is 9.0-inch d.b.h., the minimum log length is 12 feet, and the small end diameter is 7.0 inches outside bark. The minimum diameter for hardwoods is 11.0-inch d.b.h., the minimum log length is 8 feet, and the small end diameter is 9.0 inches outside bark.

Growing Stock

Net volume in cubic feet of live sawtimber trees and live poletimber trees from stump to a minimum 4.0-inch top (of central stem) outside bark is measured. Net volume equals gross volume less deduction for rot and missing bole sections.

Industrial Wood

All roundwood products, except fuelwood, are included.

Net Annual Growth

The net increase in volume of trees during a specified year. Components of net annual growth include: (a) the increment in net volume of trees at the beginning of the specified year surviving to the year's end plus (b) the net volume of trees reaching merchantable size class during the year minus (c) the net volume of trees that died during the year minus (d) the net volume of trees that become culls during the year.

Ownership Classes

National Forest lands are Federal lands which have been designated by Executive Order or statute as National Forests or purchase units and other lands under the administration of the Forest Service, including experimental areas and Bankhead-Jones Title III lands.

Other public lands are Federal lands other than National Forests, including lands administered by the Bureau of Land Management, Bureau of Indian Affairs, and miscellaneous Federal agencies, and lands owned by States, counties, and local public agencies or lands leased by these governmental units for more than 50 years.

Forest industry lands are owned by companies or individuals operating wood-using plants.

Farmer-owned lands are lands owned by operators of farms.

Miscellaneous private-corporate lands are owned by companies or corporations that do not operate wood-using plants. Included are corporate farms, some railroad lands, oil company lands, real estate and land-holding company lands, and lands held by banks and other financial institutions and various other companies and corporations.

Miscellaneous private-noncorporate lands are privately owned lands other than forest industry, farmer-owned, or corporate lands.

PLANT SPECIES

Scientific and Common Names of Plants Mentioned in This Report[2]

Abies concolor (Gord. & Glend.) Lindl.	white fir
Abies magnifica A. Murr.	California red fir
Acer macrophyllum Pursh	bigleaf maple
Adenostoma fasciculatum H. & A.	chamise
Aesculus californica (Spach) Nutt.	California buckeye
Alnus rhombifolia Nutt.	white alder
Arbutus menziesii Pursh	Pacific madrone
Arctostaphylos spp.	manzanita
Artemisia spp.	sagebrush
Atriplex spp.	saltbush
Ceanothus spp.	ceanothus
Cercis occidentalis Torr.	California redbud
Cercocarpos spp.	mountainmahogany
Chrysothamnus spp.	rabbit-brush
Juniperus occidentalis Hook.	western juniper
Juniperus osteosperma (Torr.) Little	Utah juniper
Larrea divaricata Cav.	creosote bush
Libocedrus decurrens Torr.	incense-cedar
Photinia arbutifolia Lindl.	toyon
Pinus contorta Dougl.	lodgepole pine
Pinus jeffreyi Grev. & Balf.	Jeffrey pine
Pinus lambertiana Dougl.	sugar pine
Pinus monophylla Torr. & Frém.	singleleaf pinyon
Pinus monticola Dougl.	western white pine
Pinus ponderosa Laws.	ponderosa pine
Pinus sabiniana Dougl.	Digger pine
Populus fremontii S. Wats.	Fremont cottonwood
Populus tremuloides Michx.	quaking aspen
Populus trichocarpa Torr. & Gray	black cottonwood
Pseudotsuga menziesii (Mirb.) Franco	Douglas-fir
Purshia tridentata (Pursh) DC.	bitterbrush
Quercus chrysolepis Liebm.	canyon live oak
Quercus douglasii Hook. & Arn.	blue oak
Quercus garryana Dougl. var. *semota* Jeps.	scrub oak; shin oak
Quercus kelloggii Newb.	California black oak
Quercus lobata Née	California white oak
Quercus wislizenii A. DC.	interior live oak
Sarcobatus vermiculatus (Hook.) Torr.	greasewood
Sequoiadendron giganteum (Lindl.) Buchholz	giant sequoia
Tsuga mertensiana (Bong.) Carr.	mountain hemlock
Umbellularia californica (Hook. & Arn.) Nutt.	California-laurel

---

[2] The source for most tree names is Little (1953); for other plants the source is Munz and Keck (1970). Griffin and Critchfield (1972) are authorities on tree distribution within California.

Scientific and Common Names of Mammals and Birds Mentioned in This Report

Mammals

Odocoileus hemionus (Say)	mule deer
Urocyon cinereoargenteus townsendi Merriam	grey fox
Lepus spp. Gray	rabbit
Sylvilagus (Bachman)	rabbit

Birds

Alectoris graeca	chukar
Lophortyx spp.	quail
Oreortyx spp.	quail
Columba fasciata	band-tailed pigeon

Bolsinger, Charles L.
1978. Forest area and timber resources of the San Joaquin resource area, California. USDA For. Serv. Resour. Bull. PNW-75, 71 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report presents statistics on forest area and timber volume and a description of the recent and future timber situations in Alpine, Amador, Calaveras, Fresno, Kern, Kings, Madera, Mariposa, Merced, Mono, San Joaquin, Stanislaus, Tulare, and Tuolumne Counties, California.

KEYWORDS: Forest surveys, statistics (forest), timber resources, resources (forest), California (central).

Bolsinger, Charles L.
1978. Forest area and timber resources of the San Joaquin resource area, California. USDA For. Serv. Resour. Bull. PNW-75, 71 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report presents statistics on forest area and timber volume and a description of the recent and future timber situations in Alpine, Amador, Calaveras, Fresno, Kern, Kings, Madera, Mariposa, Merced, Mono, San Joaquin, Stanislaus, Tulare, and Tuolumne Counties, California.

KEYWORDS: Forest surveys, statistics (forest), timber resources, resources (forest), California (central).

Bolsinger, Charles L.
1978. Forest area and timber resources of the San Joaquin resource area, California. USDA For. Serv. Resour. Bull. PNW-75, 71 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report presents statistics on forest area and timber volume and a description of the recent and future timber situations in Alpine, Amador, Calaveras, Fresno, Kern, Kings, Madera, Mariposa, Merced, Mono, San Joaquin, Stanislaus, Tulare, and Tuolumne Counties, California.

KEYWORDS: Forest surveys, statistics (forest), timber resources, resources (forest), California (central).

Bolsinger, Charles L.
1978. Forest area and timber resources of the San Joaquin resource area, California. USDA For. Serv. Resour. Bull. PNW-75, 71 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report presents statistics on forest area and timber volume and a description of the recent and future timber situations in Alpine, Amador, Calaveras, Fresno, Kern, Kings, Madera, Mariposa, Merced, Mono, San Joaquin, Stanislaus, Tulare, and Tuolumne Counties, California.

KEYWORDS: Forest surveys, statistics (forest), timber resources, resources (forest), California (central).

The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Developing and evaluating alternative methods and levels of resource management.
3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research are made available promptly. Project headquarters are at:

Fairbanks, Alaska
Juneau, Alaska
Bend, Oregon
Corvallis, Oregon
La Grande, Oregon
Portland, Oregon
Olympia, Washington
Seattle, Washington
Wenatchee, Washington

Mailing address: Pacific Northwest Forest and Range
Experiment Station
P.O. Box 3141
Portland, Oregon 97208

The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

The U.S. Department of Agriculture is an Equal Opportunity Employer. Applicants for all Department programs will be given equal consideration without regard to race, color, sex or national origin.

.80: PN.5-76

USDA Forest Service [redacted] PNW-76
1978

RESOURCE BULLETIN

CLEMSON UNIVERSITY LIBRARY
FEB 6 1979
SCI., TECH. & AGR. DIV.

ER RESOURCES OF WEST-CENTRAL OREGON

DAVID M. JACOBS

FIC NORTHWEST
EST AND RANGE EXPERIMENT STATION
U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
PORTLAND, OREGON

RENEWABLE RESOURCES EVALUATION WORK UNIT

Charles Van Sickle, Project Leader
Donald R. Gedney, Principal Resource Analyst
John M. Berger, Compilation Supervisor
Dale R. Baer, Field Supervisor

ACKNOWLEDGMENTS

Acknowledgment is made of the cooperation and assistance of many public agencies and private timber companies.

The U.S. Forest Service supplied forest resource data for National Forests. The Bureau of Land Management of the U.S. Department of the Interior supplied resource data for Bureau of Land Management lands.

The county assessors and several private timber companies furnished ownership information. The U.S. Forest Service, Bureau of Land Management, and several private timber companies provided maps and information on access to forest lands as well as general information related to forest management practices in Oregon.

METRIC CONVERSION

1,000 acres = 404.69 hectares
1,000 cubic feet = 28.3 cubic meters
1 cubic foot per acre = 0.0700 cubic meters per hectare
1 square foot basal area per acre = 0.2296 square meters per hectare
1 foot = 30.48 centimeters

TIMBER RESOURCES OF WEST-CENTRAL OREGON

REFERENCE ABSTRACT

Jacobs, David M.
1978. Timber resources of west-central Oregon. USDA For. Serv. Resour. Bull. PNW-76, 30 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report presents statistics from a 1975 timber resource inventory of Benton, Lane, Lincoln, and Linn Counties, Oregon. Tables are of forest area, timber volume, growth, and mortality.

KEYWORDS: Forest surveys, statistics (forest), resources (timber), west-central Oregon.

Research Summary

RESOURCE BULLETIN PNW-76

1978

The west-central Oregon resource area (Benton, Lane, Lincoln, and Linn Counties) has a total land area of 5,433,000 acres, of which 4,317,000 acres are forested, and 3,978,000 acres are in commercial forest land. The area has 87 billion board feet (Scribner rule) of standing sawtimber on commercial forest land, with 77 percent in Federal ownership.

Preface

This report presents statistics from the latest inventory of the timber resources of four counties in west-central Oregon: Benton, Lane, Lincoln, and Linn.

Field data for all lands except National Forests and lands administered by the Bureau of Land Management were collected by the Renewable Resources Evaluation Work Unit of the Pacific Northwest Forest and Range Experiment Station. Resources Evaluation (formerly Forest Survey) is a nationwide project of the Forest Service authorized by the McSweeney-McNary Forest Research Act of 1928 and amended by the Forest and Rangeland Renewable Resources Planning Act of 1974.

Resources evaluations are conducted through the 50 States by the U.S. Forest Service Experiment Stations. The Pacific Northwest Forest and Range Experiment Station at Portland, Oregon, is responsible for resources evaluations in the States of Alaska, California, Hawaii, Oregon, and Washington.

The basic inventory data for lands administered by the Bureau of Land Management (BLM) were collected by that agency in 1968. Current (1975) data were furnished by the agency on all field plots silviculturally treated or cutover since inventory, including the status of all plantations, and the 1968 inventory was updated to 1975. National Forest inventory data were collected by personnel at each National Forest. Dates of the inventories were: 1967-68 for the Umpqua National Forest; 1970-71 for the Willamette National Forest; and 1973-74 for the Siuslaw National Forest. All inventories over 5 years old were updated to 1975.

Contents

HIGHLIGHTS 1

TABLES FOR WEST-CENTRAL OREGON, JANUARY 1, [illegible] . . . . . .

RELIABILITY OF CURRENT INVENTORY DATA 23
  Forest-Land Area and Timber Volume 23

INVENTORY PROCEDURE 24
  National Forest and Bureau of Land Management Inventories . . . 24
  Inventory of Private and Other Public Lands 25

DEFINITION OF TERMS 25
  Land Area 25
  Forest-Land Classes 26
  Forest Types 26
  Tree Classes 26
  Stand-size Classes 27
  Timber Volume 27
  All Timber 27
  Net Annual Growth 28
  Net Annual Mortality 28
  Ownership Classes 28
  Miscellaneous Definitions 28

PLANT SPECIES 29

LITERATURE CITED 30

Tables

Page

1. Area by land class and county, west-central Oregon, January 1, 1976 3
2. Area of commercial forest land, by ownership class and county, west-central Oregon, January 1, 1976 3
3. Area of commercial forest land, by stand-size and ownership class, west-central Oregon, January 1, 1976 4
4. Area of commercial forest land, by cubic-foot site and ownership classes, west-central Oregon, January 1, 1976 5
5. Area of commercial forest land, by forest type and ownership class, west-central Oregon, January 1, 1976 6
6. Area of noncommercial forest land by ownership class and land class and forest type, west-central Oregon, January 1, 1976 7
7. Volume of timber on commercial forest land by class of timber and by softwoods and hardwoods, west-central Oregon, January 1, 1976 . . 8
8. Volume of growing stock and sawtimber on commercial forest land by ownership class and by softwoods and hardwoods, west-central Oregon, January 1, 1976 9
9. Volume of growing stock and sawtimber on commercial forest land by county and ownership class, west-central Oregon, January 1, 1976 . . 10
10. Volume of growing stock on commercial forest land by species and ownership class, west-central Oregon, January 1, 1976 11
11. Volume of sawtimber on commercial forest land by species and ownership class, west-central Oregon, (International 1/4-inch rule) January 1, 1976 12
12. Volume of sawtimber on commercial forest land, by species and ownership class, west-central Oregon, January 1, 1976 (Scribner rule) 13
13. Volume of growing stock on commercial forest land by species and diameter class, west-central Oregon, January 1, 1976 14
14. Volume of sawtimber on commercial forest land by species and diameter class, west-central Oregon, January 1, 1976 (International 1/4-inch rule) 15
15. Volume of sawtimber on commercial forest land by species and diameter class, west-central Oregon, January 1, 1976 (Scribner rule) 16
16. Net annual growth of growing stock and sawtimber on commercial forest land by ownership class and by softwoods and hardwoods, west-central Oregon, 1975 17
17. Net annual growth of growing stock on commercial forest land by species and ownership class, west-central Oregon, 1975 18

18. Net annual growth of sawtimber on commercial forest land by species and ownership class, west-central Oregon, 1975 (International 1/4-inch rule). 19

19. Average annual mortality of growing stock on commercial forest land by species and ownership class, west-central Oregon, 1975 . . . 20

20. Average annual mortality of sawtimber on commercial forest land by species and ownership class, west-central Oregon, 1975 (International 1/4-inch rule). 21

21. Timber harvest by ownership class, west-central Oregon, 1950-74 22

22. Confidence interval of estimate of forest area and timber volume, other than National Forest and Bureau of Land Management ownerships, west-central Oregon, January 1, 1976 23

23. Approximate confidence interval by size of estimate, other than National Forest and Bureau of Land Management, west-central Oregon, January 1, 1976. 24

ERRATA SHEET

In USDA Forest Service Resource Bulletin PNW-76, TIMBER RESOURCES OF WEST-CENTRAL OREGON, by David M. Jacobs, please correct the last item on page 1 of "Highlights" to read:

Average annual mortality

- Totaled 74 million cubic feet (397 million board feet, International 1/4-inch rule).

ALSO, replace tables 19 and 20 with these corrected tables (p. 20, 21):

GOVT. DOCUMENTS
DEPOSITORY ITEM
MAY 21 1979
CLEMSON
LIBRARY

CLEMSON UNIVERSITY LIBRARY
MAY 22 1979
TECH. & AGR. DIV.

Table 19--*Average annual mortality of growing stock on commercial forest land by species and ownership class, west-central Oregon, 1975*[1]

(In thousand cubic feet)

Species	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	33,660	18,181	5,779	765	6,282	2,653
White fir	60	60	--	--	--	--
Grand fir	825	825	--	--	--	--
Subalpine fir	548	548	--	--	--	--
Pacific silver fir	3,615	3,615	--	--	--	--
Noble fir	2,055	2,055	--	--	--	--
Sugar pine	277	277	--	--	--	--
Western white pine	8,465	8,465	--	--	--	--
Lodgepole pine	1,234	452	--	--	--	782
Engelmann spruce	91	91	--	--	--	--
Sitka spruce	240	110	--	--	130	--
Mountain hemlock	1,483	1,483	--	--	--	--
Western hemlock	7,878	6,441	353	--	723	361
Incense-cedar	236	65	40	--	73	58
Western redcedar	1,107	769	118	--	170	50
Port-Orford-cedar	86	--	--	--	86	--
Total	61,860	43,437	6,290	765	7,464	3,904
Hardwoods:						
Red alder	8,461	3,461	310	199	2,091	2,400
Oregon ash	682	--	8	--	--	674
Bigleaf maple	1,132	133	301	--	447	251
California black oak	100	--	--	--	--	100
Oregon white oak	440	--	5	--	--	435
Golden chinkapin	1,240	--	73	--	86	1,081
Pacific madrone	196	--	7	--	169	20
Total	12,251	3,594	704	199	2,793	4,961
All species	74,111	47,031	6,994	964	10,257	8,865

---

[1] See "Definition of Terms" for periods of mortality by ownership.

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
809 N.E. Sixth Avenue
Portland, Oregon 97232

Table 20--*Average annual mortality of sawtimber on commercial forest land by species and ownership class, west-central Oregon 1975*[1] *(International 1/4-inch rule)*

(In thousand board feet)

Species	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	205,499	115,707	34,596	4,470	38,364	12,362
White fir	277	277	--	--	--	--
Grand fir	4,778	4,778	--	--	--	--
Subalpine fir	1,862	1,862	--	--	--	--
Pacific silver fir	16,516	16,516	--	--	--	--
Noble fir	12,811	12,811	--	--	--	--
Sugar pine	1,808	1,808	--	--	--	--
Western white pine	50,964	50,964	--	--	--	--
Lodgepole pine	5,973	1,747	--	--	--	4,226
Engelmann spruce	1,752	1,752	--	--	--	--
Sitka spruce	1,497	685	--	--	812	--
Mountain hemlock	6,725	6,725	--	--	--	--
Western hemlock	38,406	32,299	2,361	--	2,658	1,088
Incense-cedar	896	334	208	--	354	--
Western redcedar	5,500	3,878	772	--	850	--
Port-Orford-cedar	445	--	--	--	445	--
Total	355,709	252,143	37,937	4,470	43,483	17,676
Hardwoods:						
Red alder	30,480	16,090	1,143	--	7,084	6,163
Oregon ash	4,125	--	26	--	--	4,099
Bigleaf maple	4,896	537	843	--	2,325	1,191
California black oak	--	--	--	--	--	--
Oregon white oak	1,082	--	7	--	--	1,075
Golden chinkapin	97	--	97	--	--	--
Pacific madrone	662	--	7	--	655	--
Total	41,342	16,627	2,123	--	10,064	12,528
All species	397,051	268,770	40,060	4,470	53,547	30,204

---

[1] See "Definition of Terms" for periods of mortality by ownership.

Highlights

In 1975 commercial forest land

- Covered 3,978,000 acres, 92 percent of the forest land area and 73 percent of the total land area.
- Had 67 percent of the area in site classes capable of producing more than 120 cubic feet of annual growth per acre per year.
- Was 63 percent in sawtimber stands.
- Was 65 percent in Douglas-fir type, 16 percent in other softwoods, 16 percent in hardwoods, and 3 percent in nonstocked.

Growing stock volume -

- Totaled 19,044 million cubic feet.
- Was comprised of 94-percent softwoods.
- Was 94-percent sawtimber size trees.

Sawtimber volume -

- Totaled 86,850 million board feet, Scribner rule (109,941 million board feet, International 1/4-inch rule).
- Was 77 percent in Federal ownership.
- Was 75-percent Douglas-fir species.
- Was 96-percent softwood.
- Was 78 percent in trees over 21 inches.

In 1975 ownership was distributed as follows:

Ownership	Commercial forest land area	Growing stock volume	Sawtimber volume (Scribner rule)
		(Percent)	
National Forest	41	61	63
Bureau of Land Management	11	11	13
Other Public	3	3	3
Forest Industry	28	16	14
Other Private	17	9	7

et annual growth

- Totaled 290 million cubic feet (1,574 billion board feet, International 1/4-inch rule).

verage annual mortality

- Totaled 84 million cubic feet (456 million board feet, International 1/4-inch rule).

Between 1963 and 1975 commerical forest land

- Decreased by 251,000 acres, or 6 percent. Area of sawtimber and saplings and seedlings stands decreased while the area in poletimber stands and nonstocked increased.

Growing stock volume

- Decreased by 4,578 million cubic feet, or 19 percent.

Sawtimber volume

- Decreased by 32,168 million board feet, Scribner rule, or by 27 percent (36,644 million board feet, International 1/4-inch rule, or 25 percent).

Net annual growth of growing stock

- Increased by 104 million cubic feet, or 56 percent.

Net annual sawtimber growth

- Increased by 580 million board feet, International 1/4-inch rule, or 58 percent.

Average annual timber harvest

- Was 2.45 billion board feet, Scribner scale, 28 percent of the State total.
- Was 47 percent from private lands and 53 percent from public lands.
- Was utilized as sawn lumber, 54 percent; veneer and plywood, 45 percent; and other products, 1 percent.

Table 1--*Area by land class and county, west-central Oregon, January 1, 1976*

(In thousand acres)

Land class	All counties	Benton	Lane	Lincoln	Linn
Forest land:					
Commercial	3,978	265	2,254	553	906
Productive reserved	188	([1])	127	1	60
Unproductive	151	3	96	1	51
Total	4,317	268	2,477	555	1,017
Nonforest land[2]	1,116	160	436	76	444
Total area[3]	5,433	428	2,913	631	1,461

[1] Less than 500 acres.

[2] Includes cropland, pasture and range, swampland, industrial and urban areas, powerline clearings, railroads, and all improved roads and highways, and 22,720 acres classified as water by Renewable Resources Evaluation standards, but defined by the Bureau of Census as land.

[3] Source: United States Bureau of the Census, Land and Water area of the United States, 1970.

Table 2--*Area of commercial forest land, by ownership class and county, west-central Oregon, January 1, 1976*

(In thousand acres)

Ownership class	All counties[1]	Benton	Lane	Lincoln	Linn
National Forest	1,630	14	1,119	164	333
Bureau of Land Management	441	56	279	23	83
Other public	110	29	28	25	28
Total public[1]	2,181	99	1,426	212	444
Private:					
Forest industry	1,096	52	563	251	229
Farmer-owned	237	54	66	8	109
Other private	464	60	200	81	122
Total private[1]	1,797	166	829	340	460
All ownerships[1]	3,978	265	2,254	553	906

[1] Totals may be off because of rounding.

Table 3-- [illegible]

(In thousand acres)

Stand-size class	All ownerships[1]	National Forest	Bureau of Land Management	Other public	Forest industry	Farmer and miscellaneous private
Sawtimber stands:						
Large sawtimber[2]	1,316	868	158	20	187	83
Small sawtimber[3]	1,197	394	92	89	329	293
Total	2,514	1,262	250	110	516	376
Poletimber stands	395	82	28	--	179	106
Sapling and seedling stands	839	236	139	--	338	126
Nonstocked areas	227	50	24	--	62	91
All classes[1]	3,978	1,630	441	110	1,096	701

[1] Totals may not add due to rounding.

[2] Large sawtimber includes trees 21.0 inches DBH and larger.

[3] Small sawtimber includes softwood trees 9.0 inches DBH and hardwood trees 11.0 to 20.9 inches DBH.

Table 4--*Area of commercial forest land, by cubic-foot site and ownership classes, west-central Oregon, January 1, 1976*

(In thousand acres)

Site class[1] (cubic feet)	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
225 or more	77	22	2	--	31	22
165 to 224	670	322	68	29	200	51
120 to 164	1,904	582	294	72	562	394
85 to 119	828	363	51	--	238	176
50 to 84	446	319	26	--	53	48
20 to 49	51	22	--	9	11	9
All classes[2]	3,978	1,630	441	110	1,096	701

[1] A classification in terms of capacity for cubic-foot annual growth per acre at culmination of mean annual growth in fully stocked stands.

[2] Totals may be off because of rounding.

Table 5--*Area of commercial forest land, by forest type and ownership class, west-central Oregon, January 1,* [illegible]

(In thousand acres)

Forest type	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Douglas-fir	2,585	1,102	357	65	740	321
Grand fir	30	13	1	--	--	16
Subalpine fir	5	5	--	--	--	--
Pacific silver fir	80	80	--	--	--	--
Noble fir	15	5	--	--	10	--
Ponderosa pine	3	--	--	--	--	3
Lodgepole pine	12	7	--	--	--	5
Engelmann spruce	5	5	--	--	--	--
Sitka spruce	16	10	1	--	--	5
Mountain hemlock	65	65	--	--	--	--
Western hemlock	319	133	23	--	123	40
Incense-cedar	14	13	1	--	--	--
Western redcedar	43	30	5	--	--	8
Alaska cedar	4	4	--	--	--	--
Red alder	389	82	17	35	148	107
Black cottonwood	--	--	--	--	--	--
Bigleaf maple	70	5	9	--	15	41
California black oak	5	--	--	--	--	5
Oregon white oak	65	--	--	9	--	56
Pacific madrone	40	11	--	--	10	19
Other hardwoods	28	--	4	--	5	19
Noncommercial conifers	16	7	--	--	--	9
Noncommercial hardwoods	22	3	2	--	--	17
Unclassified[2]	143	50	21	--	43	29
All types[1]	3,978	1,630	441	110	1,096	701

[1] Totals may be off because of rounding.

[2] Unclassified type has less than 10-percent stocked with all live trees.

Table 6--*Area of noncommercial forest land by ownership, land class, and forest type, west-central Oregon, January 1, 1976*

(In thousand acres)

Land class and forest type	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
			RESERVED			
Productive:						
Douglas-fir	5	--	--	5	--	--
Pacific silver fir	119	119	--	--	--	--
Lodgepole pine	64	64	--	(1)	--	--
Sitka spruce	(1)	--	--	(1)	--	--
Hemlock	(1)	--	--	(1)	--	--
Red alder	1	--	--	1	--	--
Cottonwood	(1)	--	--	(1)	--	--
Total	189	183	--	6	--	--
Unproductive:						
Pacific silver fir	23	23	--	--	--	--
Brush	--	--	--	--	--	--
Unclassified	3	3	--	(1)	--	--
Total	26	26	--	(1)	--	--
Total reserved[2]	215	209	--	6	--	--
			UNRESERVED-UNPRODUCTIVE			
Rocky:						
Douglas-fir	5	2	3	--	--	--
Western hemlock	(1)	--	(1)	--	--	--
Unclassified	10	--	--	--	10	--
Total	15	2	3	--	10	--
Low site:						
Sitka spruce	1	--	1	--	--	--
Critical watershed:						
Douglas-fir	4	4	--	--	--	--
Adverse location:						
Douglas-fir	74	74	--	--	--	--
Pacific silver fir	6	6	--	--	--	--
Noble fir	2	2	--	--	--	--
Lodgepole pine	2	2	--	--	--	--
Mountain hemlock	2	2	--	--	--	--
Western hemlock	8	8	--	--	--	--
Total	94	94	--	--	--	--
Oak - madrone	9	--	--	--	--	9
otal unreserved[2]	123	100	4	--	10	9

---

[1] Less than 500 acres.

[2] Totals may be off because of rounding.

Table [illegible]--[illegible] commercial forest land by class of timber and by softwoods and hardwoods, west-central Oregon, January 1, 1976

(In million cubic feet)

Class of timber	All species	Softwoods	Hardwoods
Sawtimber trees:			
Saw-log portion	17,193	16,490	703
Upper-stem portion	649	531	118
Total	17,842	17,021	821
Poletimber trees	1,202	864	338
All growing stock trees	19,044	17,885	1,159
Sound cull trees	118	47	71
Rotten cull trees	371	330	41
Salvable dead trees	334	330	4
All timber	19,867	18,592	1,275

Table 8--*Volume of growing stock and sawtimber on commercial forest land by ownership class and by softwoods and hardwoods, west-central Oregon, January 1, 1976*

Ownership classes	Average volume per acre	All species	Softwoods	Hardwoods
	Cubic feet	- - - -Million cubic feet- - - -		
Growing stock:[1]				
National Forest	7,117	11,600	11,304	296
Bureau of Land Management	4,803	2,118	1,979	139
Other public	5,609	617	513	104
Forest industry	2,779	3,046	2,804	242
Other private	2,372	1,663	1,285	378
All ownerships	4,787	19,044	17,885	1,159
	Board feet	- - - - -Million board feet- - - -		
Sawtimber (International 1/4-inch rule):[2]				
National Forest	42,206	68,796	67,476	1,320
Bureau of Land Management	28,810	12,705	12,216	489
Other public	30,845	3,393	3,062	331
Forest industry	15,287	16,755	16,098	657
Other private	11,829	8,292	6,893	1,399
All ownerships	27,637	109,941	105,745	4,196
Sawtimber (Scribner rule):[3]				
National Forest	33,845	55,168	54,264	904
Bureau of Land Management	25,751	11,356	10,894	462
Other public	22,627	2,489	2,227	262
Forest industry	10,992	12,047	11,520	527
Other private	8,260	5,790	4,658	1,132
All ownerships	21,833	86,850	83,563	3,287

[1] Includes trees 5.0 inches d.b.h. and larger.

[2] Includes softwood trees 9.0 inches d.b.h. and larger, and hardwood trees 11.0 inches d.b.h. and larger.

[3] Includes trees 11.0 inches d.b.h. and larger.

Table 9--Volume of growing stock and sawtimber on commercial forest land by county and ownership class, west-central Oregon, January 1, [illegible]

County	All ownership	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
	-Million cubic feet-					
Growing stock:[1]						
Benton	1,031	135	308	154	120	314
Lane	10,947	7,569	1,150	174	1,554	500
Lincoln	2,837	1,295	213	138	913	278
Linn	4,229	2,601	447	151	459	571
Total	19,044	11,600	2,118	617	3,046	1,663
	-Million board feet-					
Sawtimber (International 1/4-inch rule):[2]						
Benton	5,858	795	1,969	787	634	1,673
Lane	63.838	45,236	6,494	1,040	8,857	2,211
Lincoln	15,291	7,268	1,396	789	4,555	1,283
Linn	24,954	15,497	2,846	777	2,709	3,125
Total	109,941	68,796	12,705	3,393	16,755	8,292
Sawtimber (Scribner rule):[3]						
Benton	4,592	662	1,740	540	440	1,210
Lane	50,779	36,284	5,827	810	6,457	1,401
Lincoln	11,735	5,826	1,253	604	3,154	898
Linn	19,744	12,396	2,536	535	1,996	2,281
Total	86,850	55,168	11,356	2,489	12,047	5,790

[1] Includes trees 5.0 inches d.b.h. and larger.

[2] Includes softwood trees 9.0 inches d.b.h. and larger, and hardwood trees 11.0 inches d.b.h. and larger.

[3] Includes trees 11.0 inches d.b.h. and larger.

Table 10--*Volume of growing stock on commercial forest land by species and ownership class, west-central Oregon, January 1, 1976*

(In million cubic feet)

Species	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	13,208	7,973	1,660	512	2,066	997
White fir	4	2	2	--	--	--
Grand fir	170	127	3	--	17	23
Subalpine fir	12	12	--	--	--	--
Pacific silver fir	456	448	8	--	--	--
Noble fir	228	213	6	--	9	--
Ponderosa pine	16	11	--	1	--	4
Sugar pine	51	51	--	--	--	--
Western white pine	112	111	1	--	--	--
Lodgepole pine	36	24	--	--	--	12
Engelmann spruce	42	42	--	--	--	--
Sitka spruce	180	66	2	--	60	52
Mountain hemlock	340	340	--	--	--	--
Western hemlock	2,471	1,502	243	--	569	157
Incense-cedar	71	51	12	--	8	--
Western redcedar	481	328	40	--	74	39
Port-Orford-cedar	2	--	--	--	1	1
Alaska cedar	5	3	2	--	--	--
Total	17,885	11,304	1,979	513	2,804	1,285
Hardwoods:						
Red alder	753	246	64	82	180	181
Oregon ash	20	--	2	--	--	18
Black cottonwood	8	--	--	--	3	5
Bigleaf maple	215	42	58	15	40	60
California black oak	14	--	--	4	1	9
Oregon white oak	87	--	1	1	2	83
Golden chinkapin	46	7	13	2	6	18
Pacific madrone	16	1	1	--	10	4
Total	1,159	296	139	104	242	378
All species	19,044	11,600	2,118	617	3.046	1,663

Table 11--*Volume of sawtimber on commercial forest land by species and ownership class, west-central Oregon, (International 1/4-inch rule) January 1, 1976*

(In million board feet)

Species	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	81,352	50,361	10,402	3,055	12,173	5,361
White fir	15	8	7	--	--	--
Grand fir	951	745	13	--	77	116
Subalpine fir	41	41	--	--	--	--
Pacific silver fir	2,091	2,046	45	--	--	--
Noble fir	1,422	1,325	42	--	55	--
Ponderosa pine	99	70	--	7	--	22
Sugar pine	340	340	--	--	--	--
Western white pine	672	669	3	--	--	--
Lodgepole pine	161	96	--	--	--	65
Engelmann spruce	249	249	--	--	--	--
Sitka spruce	1,105	413	14	--	407	271
Mountain hemlock	1,637	1,635	2	--	--	--
Western hemlock	12,734	7,525	1,396	--	2,955	858
Incense-cedar	360	266	63	--	31	--
Western redcedar	2,487	1,675	219	--	393	200
Port-Orford-cedar	7	--	--	--	7	--
Alaska cedar	22	12	10	--	--	--
Total	105,745	67,476	12,216	3,062	16,098	6,893
Hardwoods:						
Red alder	2,835	1,152	252	279	470	682
Oregon ash	79	--	7	--	--	72
Black cottonwood	46	--	--	--	18	28
Bigleaf maple	812	164	201	52	152	243
California black oak	43	--	--	--	--	43
Oregon white oak	274	--	2	--	3	269
Golden chickapin	105	4	25	--	14	62
Pacific madrone	2	--	2	--	--	--
Total	4,196	1,320	489	331	657	1,399
All species	109,941	68,796	12,705	3,393	16,755	8,292

Table 12--*Volume of sawtimber on commercial forest land, by species and ownership class, west-central Oregon, January 1, 1976 (Scribner rule)*

(In million board feet)

Species	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	65,465	41,296	9,352	2,224	8,896	3,697
White fir	12	5	7	--	--	--
Grand fir	696	569	11	--	46	70
Subalpine fir	25	25	--	--	--	--
Pacific silver fir	1,475	1,439	36	--	--	--
Noble fir	1,144	1,073	37	--	34	--
Ponderosa pine	78	61	--	3	--	14
Sugar pine	279	279	--	--	--	--
Western white pine	523	521	2	--	--	--
Lodgepole pine	80	46	--	--	--	34
Engelmann spruce	192	192	--	--	--	--
Sitka spruce	832	331	13	--	317	171
Mountain hemlock	1,216	1,214	2	--	--	--
Western hemlock	9,409	5,738	1,179	--	1,942	550
Incense-cedar	273	200	57	--	16	--
Western redcedar	1,841	1,266	189	--	264	122
Port-Orford-cedar	5	--	--	--	5	--
Alaska cedar	18	9	9	--	--	--
Total	83,563	54,264	10,894	2,227	11,520	4,658
Hardwoods:						
Red alder	2,157	785	238	222	371	541
Oregon ash	69	--	6	--	--	63
Black cottonwood	43	--	--	--	17	26
Bigleaf maple	677	117	191	40	125	204
California black oak	33	--	--	--	--	33
Oregon white oak	221	--	2	--	2	217
Golden chinkapin	85	2	23	--	12	48
Pacific madrone	2	--	2	--	--	--
Total	3,287	904	462	262	527	1,132
All species	86,850	55,168	11,356	2,489	12,047	5,790

Table 13--*Volume of growing stock on commercial forest land by species and diameter class, west-central Oregon, January 1, 1976*

(In million cubic feet)

Species	Diameter class (inches at breast height)											
	All classes	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger
Softwoods:												
Douglas-fir	13,208	175	326	355	465	522	530	622	597	2,370	2,861	4,385
White fir	4	(1)	(1)	1	--	--	--	--	--	1	2	--
Grand fir	170	7	7	10	14	12	10	11	16	50	27	6
Subalpine fir	12	1	3	1	3	1	--	1	(1)	2	--	--
Pacific silver fir	456	17	24	43	38	51	47	50	41	107	32	6
Noble fir	228	1	3	5	8	10	10	17	18	51	71	34
Ponderosa pine	16	--	--	1	(1)	--	1	--	1	---	7	6
Sugar pine	51	(1)	--	--	1	1	(1)	(1)	3	11	12	23
Western white pine	112	1	3	1	5	10	9	8	6	39	25	5
Lodgepole pine	36	1	4	8	7	5	6	3	1	1	--	--
Engelmann spruce	42	--	1	1	1	3	5	5	3	15	7	1
Sitka spruce	180	3	6	5	12	6	7	16	5	21	38	61
Mountain hemlock	340	5	9	16	27	26	30	31	37	105	47	7
Western hemlock	2,471	90	136	178	169	183	189	171	176	556	436	187
Incense-cedar	71	1	3	3	5	4	2	5	3	14	20	11
Western redcedar	481	11	23	26	22	23	25	32	30	102	87	100
Port-Orford-cedar	2	(1)	1	--	--	--	--	--	--	--	1	--
Alaska cedar	5	1	(1)	--	(1)	(1)	(1)	(1)	(1)	2	1	1
Total	17,885	314	549	654	777	857	871	972	937	3,447	3,674	4,833
Hardwoods:												
Red alder	753	53	54	101	109	118	93	73	58	87	7	--
Oregon ash	20	--	--	4	5	--	3	1	5	2	--	--
Black cottonwood	8	--	--	--	--	--	--	--	--	--	8	--
Bigleaf maple	215	14	21	18	24	22	24	17	18	37	17	3
California black oak	14	--	1	4	2	3	1	3	--	--	--	--
Oregon white oak	87	4	14	13	19	8	5	6	8	8	2	--
Golden chinkapin	46	7	8	5	11	12	1	2	(1)	(1)	--	(1)
Pacific madrone	16	6	6	4	--	--	--	--	--	--	--	--
Total	1,159	84	104	149	170	163	127	102	89	134	34	3
All species	19,044	398	653	803	947	1,020	998	1,074	1,026	3,581	3,708	4,836

[1] Less than 500,000 cubic feet.

Volume of sawtimber on commercial forest land by species and diameter class, west-central Oregon, January 1, 1976 (International 1/4-inch rule)

(In million board feet)

Species	Diameter class (inches at breast height)									
	All classes	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger
Softwoods:										
Douglas-fir	86,352	1,548	2,320	2,876	3,112	3,764	3,719	15,133	18,741	30,139
White fir	15	2	--	--	--	--	--	7	6	--
Grand fir	951	42	71	63	60	67	101	319	184	44
Subalpine fir	41	6	15	3	--	7	3	7	--	--
Pacific silver fir	2,091	166	177	256	237	259	212	570	180	34
Noble fir	1,422	21	38	56	57	97	111	331	476	235
Ponderosa pine	99	4	2	--	7	--	3	--	46	37
Sugar pine	340	--	2	3	2	2	16	72	83	160
Western white pine	672	6	23	56	51	47	37	257	160	35
Lodgepole pine	161	36	39	28	32	15	6	5	--	--
Engelmann spruce	249	3	5	18	30	31	16	96	42	8
Sitka spruce	1,105	21	60	34	37	96	32	136	252	437
Mountain hemlock	1,637	58	106	116	139	153	187	556	278	44
Western hemlock	12,734	741	799	957	1,015	960	1,012	3,281	2,697	1,272
Incense-cedar	360	11	14	15	10	23	19	81	119	68
Western redcedar	2,487	101	86	104	122	171	162	588	518	635
Port-Orford-cedar	7	--	--	--	--	--	--	--	7	--
Alaska cedar	22	--	1	([1])	([1])	1	3	11	5	1
Total	105,745	2,766	3,758	4,585	4,911	5,693	5,639	21,450	23,794	33,149
Hardwoods:										
Red alder	2,835	--	494	597	488	395	327	495	39	--
Oregon ash	79	--	26	--	16	8	25	4	--	--
Black cottonwood	46	--	--	--	--	--	--	--	46	--
Bigleaf maple	812	--	96	102	119	90	102	202	93	8
California black oak	43	--	10	14	5	14	--	--	--	--
Oregon white oak	274	--	75	34	25	33	46	49	12	--
Golden chinkapin	105	--	37	51	4	5	1	3	--	4
Pacific madrone	2	--	--	--	--	--	--	2	--	--
Total	4,196	--	738	798	657	545	501	755	190	12
All species	109,941	2,766	4,496	5,383	5,568	6,238	6,140	22,205	23,984	33,161

---

[1] Less than 500,000 board feet.

Table 15--*Volume of sawtimber on commercial forest land by species and diameter class, west-central Oregon, January 1, [illegible] (Scribner rule)*

(In million board feet)

Species	All classes	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger
	Diameter class (inches at breast height)									
Softwoods:										
Douglas-fir	65,465	--	1,341	1,856	2,114	2,683	2,769	12,042	15,903	26,757
White fir	12	--	--	--	--	--	--	6	6	--
Grand fir	696	--	43	43	41	49	74	251	156	39
Subalpine fir	25	--	10	2	--	5	2	6	--	--
Pacific silver fir	1,475	--	113	181	171	193	165	467	155	30
Noble fir	1,144	--	25	39	41	71	84	268	406	210
Ponderosa pine	78	--	1	--	3	--	3	--	38	33
Sugar pine	279	--	1	2	1	2	12	56	68	137
Western white pine	523	--	15	39	36	34	28	203	136	32
Lodgepole pine	80	--	23	18	21	11	4	3	--	--
Engelmann spruce	192	--	3	12	22	22	12	78	36	7
Sitka spruce	832	--	31	20	22	64	22	105	198	370
Mountain hemlock	1,216	--	67	78	100	112	139	445	236	39
Western hemlock	9,409	--	506	633	704	714	775	2,658	2,305	1,114
Incense-cedar	273	--	8	10	6	16	14	64	95	60
Western redcedar	1,841	--	53	64	80	116	113	447	425	543
Port-Orford-cedar	5	--	--	--	--	--	--	--	5	--
Alaska cedar	18	--	1	([1])	([1])	1	2	10	3	1
Total	83,563	--	2,241	2,997	3,362	4,093	4,218	17,109	20,171	29,372
Hardwoods:										
Red alder	2,157	--	348	438	369	308	259	402	33	--
Oregon ash	69	--	21	--	14	7	23	4	--	--
Black cottonwood	43	--	--	--	--	--	--	--	43	--
Bigleaf maple	677	--	76	80	98	72	86	175	83	7
California black oak	33	--	8	10	4	11	--	--	--	--
Oregon white oak	221	--	57	27	20	27	38	42	10	--
Golden chinkapin	85	--	31	40	4	4	1	2	--	3
Pacific madrone	2	--	--	--	--	--	--	2	--	--
Total	3,287	--	541	595	509	429	407	627	169	10
All species	86,850	--	2,782	3,592	3,871	4,522	4,625	17,736	20,340	29,382

---

[1] Less than 500,000 board feet.

Table 16--*Net annual growth of growing stock and sawtimber on commercial forest land by ownership class and by softwoods and hardwoods, west-central Oregon, 1975*

Ownership classes	Average volume per acre	All species	Softwoods	Hardwoods
	Cubic feet	- - -Thousand cubic feet- - -		
Growing stock:[1]				
National Forest	42	67,691	65,405	2,286
Bureau of Land Management	86	38,123	34,188	3,935
Other public	145	15,992	12,347	3,645
Forest industry	97	106,280	93,399	12,881
Other private	89	62,165	53,221	8,944
All ownerships	73	290,251	258,560	31,691
	Board feet	- - -Thousand board feet- - -		
Sawtimber (International 1/4-inch rule):[2]				
National Forest	289	470,283	435,675	34,608
Bureau of Land Management	446	196,824	183,261	13,563
Other public	839	92,317	76,249	16,068
Forest industry	458	502,339	476,190	26,149
Other private	445	312,037	268,993	43,044
All ownerships	396	1,573,800	1,440,368	133,432

[1] Includes trees 5.0 inches d.b.h. and larger.

[2] Includes softwood trees 9.0 inches d.b.h. and larger, and hardwood trees 11.0 inches d.b.h. and larger.

Table 17--*Net annual growth of growing stock on commercial forest land by species and ownership class, west-central Oregon, 1975*

(In thousand cubic feet)

Species	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	189,696	48,533	26,307	12,278	60,874	41.704
White fir	2	-48	50	--	--	--
Grand fir	4,516	1,251	1,244	--	805	1,216
Subalpine fir	-134	-134	--	--	--	--
Pacific silver fir	1,878	1,772	106	--	--	--
Noble fir	428	-69	70	--	427	--
Ponderosa pine	173	33	--	69	--	71
Sugar pine	77	77	--	--	--	--
Western white pine	-9,547	-9,553	6	--	--	--
Lodgepole pine	-384	129	--	--	--	-513
Engelmann spruce	294	294	--	--	--	--
Sitka spruce	5,571	1,145	20	--	1,587	2,819
Mountain hemlock	5,639	5,638	1	--	--	--
Western hemlock	51,566	12,096	5,516	--	27,471	6,483
Incense-cedar	1,113	499	214	--	400	--
Alaska cedar	20	71	7	--	--	-58
Western redcedar	7,633	3,671	647	--	1,885	1,430
Port-Orford-cedar	19	--	--	--	-50	69
Total	258,560	65,405	34,188	12,347	93,399	53,221
Hardwoods:						
Red alder	22,212	1,068	1,820	2,933	11,007	5,384
Oregon ash	-1	4	41	--	--	-46
Black cottonwood	142	--	--	--	71	71
Bigleaf maple	5,561	955	1,638	423	1,058	1,487
California black oak	227	--	--	118	46	63
Oregon white oak	1,963	--	26	103	85	1,749
Golden chinkapin	701	245	376	68	256	-244
Pacific madrone	886	14	34	--	358	480
Total	31,691	2,286	3,935	3,645	12,881	8,944
All species	290,251	67,691	38,123	15,992	106,280	62,165

Table 18--*Net annual growth of sawtimber on commercial forest land by species and ownership class, west-central Oregon, 1975 (International 1/4-inch rule)*

(In thousand board feet)

Species	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	1,068,746	334,611	142,621	75,849	313,275	202,390
White fir	-511	-640	129	--	--	--
Grand fir	26,163	9,487	4,975	--	4,825	6,876
Subalpine fir	370	370	--	--	--	--
Pacific silver fir	16,014	15,252	762	--	--	--
Noble fir	13,134	9,586	544	--	3,004	--
Ponderosa pine	1,334	240	--	400	--	694
Sugar pine	2,145	2,145	--	--	--	--
Western white pine	-42,188	-42,224	36	--	--	--
Lodgepole pine	-2,503	-103	--	--	--	-2,400
Engelmann spruce	1,877	1,877	--	--	--	--
Sitka spruce	35,823	8,812	177	--	9,838	16,996
Mountain hemlock	30,069	30,062	7	--	--	--
Western hemlock	242,402	40,388	30,202	--	135,978	35,834
Incense-cedar	5,791	4,340	804	--	647	--
Alaska cedar	217	165	52	--	--	--
Western redcedar	41,698	21,307	2,952	--	8,836	8,603
Port-Orford-cedar	-213	--	--	--	-213	--
Total	1,440,368	435,675	183,261	76,249	476,190	268,993
Hardwoods:						
Red alder	94,306	29,656	7,404	13,780	20,147	23,319
Oregon ash	264	--	157	--	--	107
Black cottonwood	877	--	--	--	439	438
Bigleaf maple	21,934	4,892	5,329	2,288	4,703	4,722
California black oak	1,342	--	--	--	--	1,342
Oregon white oak	8,659	--	46	--	53	8,560
Golden chinkapin	6,666	60	588	--	1,462	4,556
Pacific madrone	-616	--	39	--	-655	--
Total	133,432	34,608	13,563	16,068	26,149	43,044
All species	1,573,800	470,283	196,824	92,317	502,339	312,037

Table 19--Average annual mortality of growing stock on commercial forest land, by species and ownership class, west-central region, [illegible][1]

(In thousand cubic feet)

Species	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	36,195	20,716	5,779	765	6,282	2,653
White fir	60	60	--	--	--	--
Grand fir	847	847	--	--	--	--
Subalpine fir	548	548	--	--	--	--
Pacific silver fir	4,336	4,336	--	--	--	--
Noble fir	2,695	2,695	--	--	--	--
Sugar pine	277	277	--	--	--	--
Western white pine	10,473	10,473	--	--	--	--
Lodgepole pine	1,253	471	--	--	--	782
Engelmann spruce	91	91	--	--	--	--
Sitka spruce	392	262	--	--	130	--
Mountain hemlock	1,796	1,796	--	--	--	--
Western hemlock	9,886	8,449	353	--	723	361
Incense-cedar	239	68	40	--	73	58
Western redcedar	1,241	903	118	--	170	50
Port-Orford-cedar	86	--	--	--	86	--
Total	70,415	51,992	6,290	765	7,464	3,904
Hardwoods:						
Red alder	10,112	5,112	310	199	2,091	2,400
Oregon ash	682	--	8	--	--	674
Bigleaf maple	1,181	182	301	--	447	251
California black oak	100	--	--	--	--	100
Oregon white oak	440	--	5	--	--	435
Golden chinkapin	1,240	--	73	--	86	1,081
Pacific madrone	196	--	7	---	169	20
Total	13,951	5,294	704	199	2,793	4,961
All species	84,366	57,286	6,994	964	10,257	8,865

---

[1] See "Definition of Terms" for periods of mortality by ownership.

Table 20--*Average annual mortality of sawtimber on commercial forest land by species and ownership class, west-central Oregon*[1] *(International 1/4-inch rule)*

(In thousand board feet)

Species	All ownerships	National Forest	Bureau of Land Management	Other public	Forest industry	Other private
Softwoods:						
Douglas-fir	221,195	131,403	34,596	4,470	38,364	12,362
White fir	277	277	--	--	--	--
Grand fir	4,908	4,908	--	--	--	--
Subalpine fir	1,862	1,862	--	--	--	--
Pacific silver fir	19,807	19,807	--	--	--	--
Noble fir	16,801	16,801	--	--	--	--
Sugar pine	1,808	1,808	--	--	--	--
Western white pine	66,044	66,044	--	--	--	--
Lodgepole pine	6,048	1,822	--	--	--	4,226
Engelmann spruce	1,752	1,752	--	--	--	--
Sitka spruce	2,443	1,631	--	--	812	--
Mountain hemlock	8,230	8,230	--	--	--	--
Western hemlock	48,339	42,232	2,361	--	2,658	1,088
Incense-cedar	912	350	208	--	354	--
Western redcedar	6,215	4,593	772	--	850	--
Port-Orford-cedar	445	--	--	--	445	--
Total	407,086	303,520	37,937	4,470	43,483	17,676
Hardwoods:						
Red alder	38,234	23,844	1,143	--	7,084	6,163
Oregon ash	4,125	--	26	--	--	4,099
Bigleaf maple	5,136	777	843	--	2,325	1,191
Oregon white oak	1,082	--	7	--	--	1,075
Golden chinkapin	97	--	97	--	--	--
Pacific madrone	662	--	7	--	655	--
Total	49,336	24,621	2,123	--	10,064	12,528
All species	456,422	328,141	40,060	4,470	53,547	30,204

---

[1] See "Definition of Terms" for periods of mortality by ownership.

Table 21--*Timber harvest by ownership class, west-central Oregon, 1950-74*

(Thousand board feet, Scribner scale)

Year	All ownerships	Private			State	National Forest	Bureau of Land Management	Other public
		Forest Industry	Other private	Total private				
1950	2,331,357	--	--	(1)	1,954,955	348,400	--	28,002
1951	2,371,536	--	--	(1)	2,000,236	352,300	--	19,000
1952	2,869,267	--	--	(1)	2,415,179	439,600	--	14,488
1953	2,468,737	--	--	(1)	2,002,460	465,600	--	677
1954	2,383,393	--	--	(1)	1,833,821	549,000	--	572
1955	2,487,500	--	--	(1)	1,916,696	570,804	--	--
1956	2,415,482	--	--	(1)	1,726,225	554,100	135,157	--
1957	2,039,793	--	--	(1)	1,366,861	538,900	134,032	--
1958	1,918,823	(2)	(2)	1,044,480	15,390	683,837	175,116	--
1959	2,100,762	(2)	(2)	945,419	15,505	932,568	207,270	--
1960	2,266,043	(2)	(2)	1,296,745	20,355	763,302	185,641	--
1961	2,421,912	(2)	(2)	1,428,615	16,100	762,089	215,108	--
1962	2,773,658	1,260,115	133,653	1,393,768	16,631	1,126,000	237,259	--
1963	2,713,692	1,088,315	204,413	1,292,728	19,535	1,046,400	355,029	--
1964	2,842,386	1,139,582	161,292	1,300,874	25,736	1,052,500	463,276	--
1965	2,766,278	973,850	231,220	1,205,070	42,510	1,229,400	284,380	4,918
1966	2,612,061	1,140,459	178,278	1,318,737	21,611	993,900	271,202	6,611
1967	2,440,272	1,070,118	273,915	1,344,033	9,565	884,200	201,676	798
1968	2,805,419	965,282	447,776	1,413,058	17,586	1,097,238	276,947	590
1969	2,523,814	716,553	399,811	1,116,364	25,871	1,063,764	317,240	575
1970	2,219,631	983,891	150,804	1,134,695	24,142	845,337	215,457	--
1971	2,412,567	1,004,618	154,765	1,159,383	16,638	960,677	275,864	5
1972	2,737,486	932,636	209,789	1,142,425	51,959	1,189,473	353,434	195
1973	2,794,172	943,306	265,710	1,209,016	32,547	1,200,929	351,595	85
1974	2,267,280	883,883	170,564	1,054,447	39,256	926,782	246,795	--

[1] Separate data for private and State ownership not available.

[2] Separate data for forest industry and other private ownership not available.

Reliability of Current Inventory Data

FOREST-LAND AREA AND TIMBER VOLUME

The estimates of forest-land area and timber volume in west-central Oregon for all owners other than National Forest and Bureau of Land Management were derived by sampling and consequently have sampling errors. Area and volume statistics for National Forests and BLM were updated with a stand projection model (Larson and Goforth 1970), and therefore, confidence intervals were not computed. Sampling intensities on BLM and National Forests were four times greater than other lands. Therefore, assuming approximately the same variability, the precision of estimate of these inventories will exceed the precision shown below for the other owners.

Confidence intervals have been computed for the estimates of commercial and noncommercial forest-land area, net cubic-foot volume of growing stock, and net board-foot volume (International 1/4-inch scale) of sawtimber. These confidence intervals computed at the 68- and 95-percent probability level are presented in table 22 as a percent of the estimated total. They may be interpreted as meaning that the odds are two out of three for 68-percent probability, or 19 out of 20 for 95-percent probability, that the confidence intervals shown include the true value (i.e., the results of a 100-percent inventory). For example, we can expect, with 95-percent confidence, that the estimate of total commercial forest-land area--1,907,000 acres ± 2.5 percent (47,675 acres)--includes the true value.

In addition to measurable confidence intervals, there may be other nonsampling errors caused by mistakes in judgment, measurement, and compilation. The magnitude of errors from these sources cannot be determined. Such errors are controlled by training, supervising, and field checking of field crews, and complete editing when compiling the data.

The precision of any breakdown of these totals will be substantially less than that for the total. An

Table 22--*Confidence interval of estimate of forest area and timber volume, other than National Forest and Bureau of Land Management ownerships, west-central Oregon, January 1, 1976*

Item	Estimated total	Confidence interval in percent	
		68-percent probability	95-percent probability
Commercial forest land	1,907,000 acres	± 1.3	± 2.5
Noncommercial forest land	19,000 acres	±70.7	±138.6
Volume:			
Growing stock	5,326 million cubic feet	± 6.2	± 12.2
Sawtimber (International 1/4-inch rule)	28,440 million board feet	± 8.1	± 15.9

approximation of the relative precision for various subdivisions of total estimates can be obtained from table 23.

Inventory Procedure

This report of west-central Oregon's forest resources combines data from three National Forest inventories, one Bureau of Land Management inventory, and an inventory of the private, State, county, and municipal lands conducted by the Renewable Resources Evaluation Work Unit of the Pacific Northwest Forest and Range Experiment Station. The Bureau of Land Management inventory and National Forest inventories more than 5 years old have been updated to account for cutting, reforestation, growth, and mortality since the dates of inventory.

NATIONAL FOREST AND BUREAU OF LAND MANAGEMENT INVENTORIES

The National Forest and Bureau of Land Management inventories were all systematic samples with field plots distributed on a square grid. For the Umpqua National Forest inventory, volume, area, and growth data were expanded from field plots, with each plot having equal weight.

On the Willamette and Siuslaw National Forests, nonforest, noncommercial forest, and clearcut areas were mapped and the field sample restricted to commercial forest land, exclusive of clearcuts. Inventory data on clearcuts came from forest records based on plantation and compartment examinations.

On the National Forest and Bureau of Land Management inventories, the field plot used was a cluster of 10

Table 23--*Approximate confidence interval by size of estimate, other than National Forest and Bureau of Land Management, west-central Oregon, January 1, 1976*

Commercial forest land		Noncommercial forest land		Growing stock		Sawtimber	
Area	Confidence interval[1]	Area	Confidence interval[1]	Volume	Confidence interval[1]	Volume	Confidence interval[1]
Thousand acres	Percent	Thousand acres	Percent	Million cubic feet	Percent	Million board feet[2]	Percent
2,000	1.3			6,000	5.8	30,000	7.9
1,000	1.8			4,000	7.2	28,000	8.2
800	2.0			2,000	10.1	26,000	8.5
600	2.3			1,000	14.3	24,000	8.8
400	2.8			800	16.0	22,000	9.2
200	4.0			600	18.5	20,000	9.7
100	5.7			400	22.6	10,000	13.7
50	8.0			200	32.0	5,000	19.3
25	11.4	25	61.6	100	45.2	1,000	43.2
10	18.0	10	97.4	50	64.0	800	48.3
5	25.4	5	137.8	25	90.5	600	55.8
3	32.8	3	177.9	10	143.1	400	68.3
1	56.8	1	308.2	5	202.4	200	96.6
				3	261.2	100	136.6
				1	452.5		

These proportions or relationships between size of area or volume hold only if one assumes constant variance (i.e., the variability among observations is constant regardless of description of the subset).

[1] By random sampling formula; 68-percent probability.

[2] International 1/4-inch rule.

variable-radius points sampling an acre. Seedlings and saplings were sampled on small fixed-radius plots located at each of the 10 points.

For the Umpqua National Forest inventory, growth and mortality were updated by stand projection (Larson and Goforth 1970). In addition, all plots cut since inventory were identified and assigned new area classifications based on data furnished by the Bureau of Land Management and the Forest Service.

Inventory	Number of plots	Field plot grid intensity	Inventory date	Updated to
Siuslaw National Forest	337	1.7	1974	--
Willamette National Forest	507	1.7	1971	--
Umpqua National Forest	79	1.7	1968	1975
Salem BLM District	336	1.7	1968	1975
Eugene BLM District	299	1.7	1968	1975
Roseburg BLM District	1	1.7	1968	1975
Private, State, county, and municipal lands	384	3.4	1975	--

INVENTORY OF PRIVATE AND OTHER PUBLIC LANDS

The sampling design used double sampling for stratification (Cochran 1963). Classification on about 6,200 photo points were used to divide the inventory unit into a series of strata based on: (1) owner group; (2) major land class (commercial forest, noncommercial forest, and nonforest); and (3) stand volume class.

The same 10-point field plot design that had been used on the National Forest and Bureau of Land Management inventories were used in this inventory. Unlike those inventories, however, most of the field plots that were originally established in 1961 and 1962 were remeasured for this inventory. Most growth and mortality estimates were made by comparing old and new tallies on remeasured trees. When new trees were tallied, growth data came from increment cores and mortality data came from ocular estimates of time of death.

Definition of Terms

Unless otherwise noted, definitions apply to all inventories referenced in this report.

LAND AREA

Total land area is that reported by the Bureau of the Census. Total land area includes dry land and land temporarily or partially covered by water, such as marshes, swamps, and river flood plains; streams, sloughs, and canals less than one-eighth-mile wide; and lakes, reservoirs, and ponds less than 40 acres in area.

Forest land is land at least 10 percent stocked by live trees or land formerly having such tree cover and not currently developed for nonforest use. Minimum area of forest land recognized is 1 acre.

Nonforest land is land that has never supported forests or land that was formerly forested and is currently developed for nonforest uses. Included are lands used for agricultural crops, improved pasture, residential areas, city parks, improved roads, and operating railroads and their right-of-way clearings, powerline and pipeline clearings, and 1- to 40-acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads, and other, nonforest strips must be more than 120 feet wide, and clearings, etc., more than 1 acre in size, to qualify as nonforest land.

FOREST-LAND CLASSES

Commercial forest land is land capable of producing 20 cubic feet per acre per year of industrial wood and is not withdrawn from timber utilization.

Noncommercial forest land is land incapable of yielding crops of industrial wood because of adverse site conditions, or it is productive public forest land withdrawn from commercial timber use through statute or administrative regulation.

Productive-reserved forest land is public land withdrawn from timber utilization through statute, ordinance, or administrative order but which otherwise qualifies as commercial forest land.

Unproductive forest land is land incapable of yielding crops of industrial wood products because of adverse site conditions such as sterile soils, poor drainage, high elevation, steepness, and rockiness.

FOREST TYPES

Stands with 50 percent or more stocking in live conifer trees are called softwood types. Stands with a majority of stocking in live hardwood trees are classed as hardwood types. Within these two type groups, the individual forest type is determined by plurality of stocking by species of live softwood or hardwood trees.

TREE CLASSES

Growing Stock

Growing stock trees are live trees of commercial species which meet the minimum merchantability standards for sawtimber, poletimber, or seedling and sapling trees.

Sawtimber trees are growing stock trees at least 9.0 inches in d.b.h. if they are softwoods and at least 11.0 inches in d.b.h. if they are hardwoods. At least 25 percent of board-foot volume in a sawtimber tree must be free from defect. Softwood trees must contain at least one 12-foot saw log with a top diameter of not less than 6 inches inside the bark; hardwood trees must contain at least one 8-foot saw log with a top diameter of not less than 8 inches inside the bark.

Poletimber trees are growing stock trees 5.0 to 8.9 inches in d.b.h. if they are softwoods and 5.0 to 10.9 inches in d.b.h. for hardwoods, with a cubic-foot volume of wood at least 50-percent free from defect. They are free from any disease, defect, or deformity which is likely to prevent their becoming sawtimber trees.

Sapling and seedling trees are growing stock trees less than 5.0 inches in d.b.h. that have no disease, defects, or deformities likely to prevent their becoming growing stock poletimber trees.

Nongrowing Stock

Cull trees are noncommercial species or commercial species which are too defective or which are unlikely to become growing stock trees because of deformity, disease, low vigor, etc.

Sound cull trees are noncommercial species or commercial species with excessive defect caused by form, roughness, etc.

Rotten cull trees have excessive defect primarily caused by rot.

Salvable dead trees are standing or down trees of commercial species, 9.0 inches or more in diameter for softwoods and 11.0 inches or more in diameter for hardwoods, containing 25 percent or more of sound volume and at least one merchantable 16-foot log if softwood or one merchantable 8-foot log if hardwood.

Mortality Trees

Commercial species which died from natural causes within a specified period and which were growing stock trees at the time of death.

STAND-SIZE CLASSES

Sawtimber stands are at least 10 percent stocked with growing stock conifer, red alder, and black cottonwood trees, with half or more of this stocking in sawtimber and poletimber trees and with sawtimber stocking equal to or greater than poletimber stocking. In *large sawtimber stands*, the majority of the sawtimber stocking is in trees 21.0 inches and larger at breast height. In *small sawtimber stands*, the majority of the sawtimber stocking is in trees from 9.0 to 20.9 inches at breast height.

Poletimber stands are at least 10 percent stocked with growing stock conifer, red alder, and black cottonwood trees, with half or more of this stocking in sawtimber and poletimber trees, and with poletimber stocking exceeding sawtimber stocking.

Sapling and seedling stands are at least 10 percent stocked with growing stock conifer, red alder, and black cottonwood trees, with more than half of this stocking in saplings, seedlings, or both.

Nonstocked areas of commercial forest land are less than 10 percent stocked with growing stock conifer, red alder, and black cottonwood trees.

TIMBER VOLUME

Live Sawtimber

Net volume of live sawtimber trees of commercial species is measured in board feet. Net volume equals gross volume less deduction for rot, sweep, crook, and other defects that affect use for lumber.

Scribner rule is the common board-foot log rule used locally in determining volume of sawtimber. Scribner volume is measured in terms of 32-foot logs.

International 1/4-inch rule is the standard board-foot log rule adopted nationally by the Forest Service for the presentation of Renewable Resources Evaluation volume statistics.

Saw-log portion is the bole of sawtimber trees between the stump and the saw-log top.

Upper-stem portion includes the bole of sawtimber trees above the saw-log top of 7.0 inches outside bark for softwoods and 8.0 inches outside bark for hardwoods to a minimum top diameter of 4.0 inches outside bark, or to the point where the central stem breaks into limbs.

Growing Stock

Net volume of growing stock is measured in cubic feet of live sawtimber trees and live poletimber trees from stump to a minimum 4.0-inch top (of central stem) outside bark. Net volume equals gross volume less deduction for rot and missing bole sections.

ALL TIMBER

All timber includes the net volume in cubic feet of live growing-stock poletimber and sawtimber trees and salvable dead sawtimber trees of commercial species and the gross volume in cubic feet of cull trees of all species. Volume is measured from stump to a minimum 4.0-inch top outside bark.

NET ANNUAL GROWTH

Components of net annual growth include: (a) the increment in net volume of trees at the beginning of the specified year surviving to the year's end plus (b) the net volume of trees reaching the size class during the year minus (c) the net volume of trees that died during the year minus (d) the net volume of trees that became culls during the year.

NET ANNUAL MORTALITY

Mortality data is reported as periodic annual mortality. In west-central Oregon, the periods are as follows:

BLM - 5 years -- 1963 to 1968
Siuslaw National Forest -
  10/11 years -- 1963 to 1973/74
Umpqua National Forest -
  9/10 years -- 1958 to 1967/68
Willamette National Forest -
  10/11 years -- 1961 to 1970/71
Private and other public -
  13/14 years -- 1961/62 to 1975

OWNERSHIP CLASSES

National Forest lands are Federal lands which have been designated by Executive order or statute as National Forest or purchase units and other lands under the administration of the Forest Service, including experimental areas and Bankhead-Jones title III lands.

Other public lands are Federal lands other than National Forests or lands administered by the Bureau of Land Management and lands owned by States, counties, and local public agencies or leased by these governmental units for more than 50 years.

Forest industry lands are lands owned by companies or individuals operating wood-using plants.

Other private lands include all private lands except those classed as forest industry lands.

MISCELLANEOUS DEFINITIONS

A *short log* is a standard 16-foot log.

A *long log* is a standard 32-foot log.

Plantation examination is the examination of an artificially reforested area established by planting or direct seeding.

Compartment examination is the examination of a small subdivision of forest area defined by permanent boundaries and used for orientation, administration, and silvicultural operations.

Plant Species

This list includes the important tree species occurring in west-central Oregon. The source for scientific names is Little (1953).

Scientific name	Common name
Abies amabilis (Dougl.) Forbes	Pacific silver fir
Abies concolor (Gord. & Glend.) Lindl.	white fir
Abies grandis (Dougl.) Lindl.	grand fir
Abies lasiocarpa (Hook.) Nutt.	subalpine fir
Abies procera Rehd.	noble fir
Chamaecyparis lawsoniana (A. Murr.) Parl.	Port-Orford-cedar
Chamaecyparis nootkatensis (D. Don) Spach	Alaska-cedar
Libocedrus decurrens Torr.	incense-cedar
Picea engelmannii Parry	Engelmann spruce
Picea sitchensis (Bong.) Carr.	Sitka spruce
Pinus albicaulis Engelm.	whitebark pine
Pinus attenuata Lemm.	knobcone pine
Pinus contorta Dougl.	lodgepole pine
Pinus monticola Dougl.	western white pine
Pinus ponderosa Laws.	ponderosa pine
Pseudotsuga menziesii (Mirb.) Franco	Douglas-fir
Thuja plicata Donn	western redcedar
Tsuga heterophylla (Raf.) Sarg.	western hemlock
Tsuga mertensiana (Bong.) Carr.	mountain hemlock
Hardwood trees:	
Acer macrophyllum Pursh	bigleaf maple
Alnus rhombifolia Nutt.	white alder
Alnus rubra Bong.	red alder
Arbutus menziesii Pursh	Pacific madrone
Castanopsis chrysophylla (Dougl.) A. DC.	golden chinkapin
Fraxinus latifolia Benth.	Oregon ash
Populus trichocarpa Torr. & Gray	black cottonwood
Quercus chrysolepis Leibm.	canyon live oak
Quercus garryana Dougl.	Oregon white oak
Quercus kelloggii Newb.	California black oak
Umbellularia californica (Hook. & Arn.) Nutt.	California-laurel (Oregon-myrtle)

Literature Cited

Cochran, W. G.
1963. Sampling techniques. 2d ed., 413 p. John Wiley & Sons, Inc., New York.

Larson, Robert W., and Marcus H. Goforth.
1970. TRAS, a computer program for the projection of timber volume. U.S. Dep. Agric., Agric. Handb. 377, 24 p., illus.

Little, Elbert L., Jr.
1953. Check list of native and naturalized trees of the United States (including Alaska). U.S. Dep. Agric., Agric. Handb. 41, 472 p.

☆ U.S. GOVERNMENT PRINTING OFFICE 1978—797-325/200 REGION 10

Jacobs, David M.
1978. Timber resources of west-central Oregon. USDA For. Serv. Serv. Resour. Bull. PNW-76, 30 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report presents statistics from a 1975 timber resource inventory of Benton, Lane, Lincoln, and Linn Counties, Oregon. Tables are of forest area, timber volume, growth, and mortality.

KEYWORDS: Forest surveys, statistics (forest), resources (timber), west-central Oregon.

Jacobs, David M.
1978. Timber resources of west-central Oregon. USDA For. Serv. Serv. Resour. Bull. PNW-76, 30 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report presents statistics from a 1975 timber resource inventory of Benton, Lane, Lincoln, and Linn Counties, Oregon. Tables are of forest area, timber volume, growth, and mortality.

KEYWORDS: Forest surveys, statistics (forest), resources (timber), west-central Oregon.

Jacobs, David M.
1978. Timber resources of west-central Oregon. USDA For. Serv. Serv. Resour. Bull. PNW-76, 30 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report presents statistics from a 1975 timber resource inventory of Benton, Lane, Lincoln, and Linn Counties, Oregon. Tables are of forest area, timber volume, growth, and mortality.

KEYWORDS: Forest surveys, statistics (forest), resources (timber), west-central Oregon.

Jacobs, David
1978. Timber resources of west-central Oregon. USDA For. Serv. Serv. Resour. Bull. PNW-76, 30 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report presents statistics from a 1975 timber resource inventory of Benton, Lane, Lincoln, and Linn Counties, Oregon. Tables are of forest area, timber volume, growth, and mortality.

KEYWORDS: Forest surveys, statistics (forest), resources (timber), west-central Oregon.

Coc
l

Lar
l

Lit
l

The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Developing and evaluating alternative methods and levels of resource management.
3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research are made available promptly. Project headquarters are at:

Fairbanks, Alaska
Juneau, Alaska
Bend, Oregon
Corvallis, Oregon
La Grande, Oregon
Portland, Oregon
Olympia, Washington
Seattle, Washington
Wenatchee, Washington

Mailing address: Pacific Northwest Forest and Range
Experiment Station
P.O. Box 3141
Portland, Oregon 97208

The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

The U.S. Department of Agriculture is an Equal Opportunity Employer. Applicants for all Department programs will be given equal consideration without regard to race, color, sex or national origin.

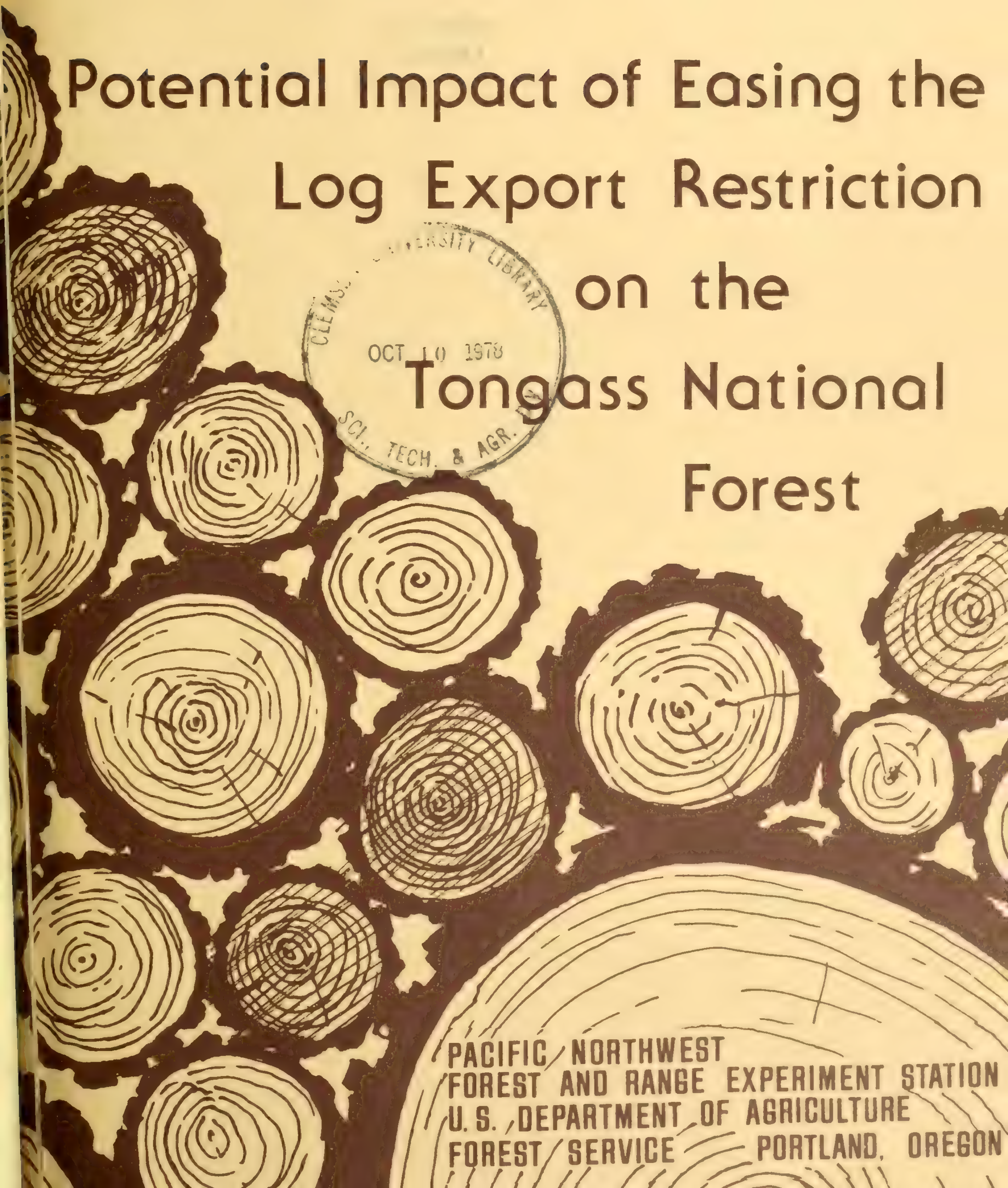
1978

USDA FOREST SERVICE RESOURCE BULLETIN PNW-77

David R. Darr

Potential Impact of Easing the Log Export Restriction on the Tongass National Forest

CLEMSON UNIVERSITY LIBRARY
OCT 10 1978
SCI., TECH. & AGR.



PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION
U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE PORTLAND, OREGON

CONTENTS

Page

BACKGROUND 1
  Structure of the Timber Market in Southeast Alaska . . 2
  Structure of the Japanese Log Market 4

POTENTIAL IMPACTS OF CHANGE 8
  Demand Responses in Japan 8
  Supply Responses 9
  The Conceptual Model 10
  Price Impacts in Japan 12
  Impacts in Alaskan Timber Market 13

IMPLICATIONS OF ANALYSIS OF IMPACTS 15
  Stumpage Revenues 15
  Industry Stability 16
  Relation to Previous Work 16
  Export Policy 16

LITERATURE CITED 17

POTENTIAL IMPACTS OF EASING THE LOG EXPORT RESTRICTION ON THE TONGASS NATIONAL FOREST

Reference Abstract

Darr, David R.
1978. Potential impacts of easing the log export restriction on the Tongass National Forest. USDA For. Serv. Resour. Bull. PNW-77, 18 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oregon.

The potential of higher revenues in the log export market is constrained by possible reductions in prices associated with expanded supplies in the Japanese log market. Expanded log exports from the Tongass National Forest might force adjustments by existing cantmills, even under a partial easing of the export restriction.

KEYWORDS: Import/export (forest products), trade policy (international), market prices, supply/demand (forest products), Alaska (Tongass National Forest).

Research Summary

RESOURCE BULLETIN PNW-77

1978

A longstanding restriction on the export of roundwood logs may restrict the flexibility of the U.S. Forest Service in formulating policies to respond to current competing demands on the timber resource of the Tongass National Forest. Concerns of the agency include stumpage revenues and the stability of existing industry. The potential of higher revenues in the log export market is constrained by possible reductions in prices associated with expanded supplies in the Japanese log market. Expanded log exports from the Tongass National Forest might force adjustments by existing cantmills, even under a partial easing of the export restriction.

BACKGROUND

A longstanding restriction on the management of National Forest lands in southeast Alaska is a prohibition on the export of unprocessed logs beyond the State's borders. Forest Service efforts to control exports date from 1928 (Lindell 1978). The intent of this paper is to lay out a framework for identifying the potential extent of consequences of lifting the restriction on log exports. No attempt, however, is made to weigh these consequences for the purposes of making a recommendation on what log export policy should be. The U.S. Forest Service in southeast Alaska is responsible for rationalizing export and other policies with the goals and objectives of land management. A key to policy formulation, however, is the identification of possible impacts flowing from a change in policy.

The U.S. Forest Service has many objectives in pursuing its land management responsibilities in southeast Alaska. These objectives are not necessarily clearly defined and may conflict. Objectives flow from legislation such as the Multiple Use-Sustained Yield Act of 1960 [74 Stat. 215; 16 U.S.C. 528-531] and the National Forest Management Act of 1976 [P.L. 94-588]. Overlaid on the rather specific guidelines flowing from legislative mandates are rather vague, imprecise national directions related to employment, price stability, economic efficiency, foreign relations, small business, economic growth and development, community stability, and national security. Ideally, analysis of a change in U.S. Forest Service policy would display the consequences of a change in policy for each of the agency's objectives or concerns. For the purposes of this paper the assessment of consequences is limited to two concerns or objectives for managing the Tongass National Forest. Either through public statements or implicitly through its actions, U.S. Forest Service management in southeast Alaska has expressed concern over the stability of existing industry and stumpage revenues. The importance of these two concerns in determing land management policies of the agency depends on the weights attached to them compared with weights given to other concerns.

In regards to the stability of existing industry, the concern is that a change in export policy might threaten the viability of existing industry with coincident adverse impacts on employment, income, and other aspects of community life in southeast Alaska.

The U.S. Forest Service is charged with obtaining fair market value for timber sold from lands under its management. In regard to stumpage revenues, the concern is that the existing export restriction may be constraining the market for the agency's timber to the point of reducing stumpage revenues. An easing of the export restriction might enhance returns to the Treasury.

The impacts of a policy change on the stability of existing industry and on stumpage revenues will depend on how forest products markets respond. The current export restriction can be viewed as a constraint on the actions of producers and consumers which comprise the marketing chain from standing trees to final end use. An understanding of the details of the forest products markets in southeast Alaska is essential to maintain this market perspective: How does the U.S. Forest Service sell timber; who buys it, and where does the finished product go?

Structure of the Timber Market in Southeast Alaska

The U.S. Forest Service currently manages about 90 percent of the timber inventory in southeast Alaska. Over 99 percent of this inventory is classed as softwoods (Hutchison 1968, pp. 64-65). There are some scattered private lands, but most of the remaining 10 percent is under the control of other public agencies. Transportation costs and other factors which isolate Alaska generally prevent the movement of timber from other areas into southeast Alaska. Because of this isolation, the U.S. Forest Service can be viewed as being in a monopoly position in the sale of timber. The agency's behavior, however, does not correspond with what could be expected of a practicing monopolist.

The maximum volume which the U.S. Forest Service can offer for sale each year in southeast Alaska is constrained by a combination of the biological allowable cut and the level of appropriated funds. The annual allowable cut is based on the physical characteristics of each forest and on multiple-use considerations. The level of appropriated funds determines how much operating money the agency has to lay out and administer timber sales and carry on other land management activities. The level of appropriated funds may constrain sales offerings to less than the annual allowable cut.

The U.S. Forest Service, through a timber appraisal process, establishes a minimum appraised price for each sales offering and will not accept any price below this minimum. Each timber sale is advertised and an auction held. Participants in the auction may bid more but not less than the appraised price.

The appraised price for standing timber is calculated as a residual value. In the appraisal process, the U.S. Forest Service makes an assumption about what end products will be manufactured from the standing timber. End product prices are then multiplied by estimates of product yields from the timber sale volume. Estimates of product manufacturing and logging costs and a margin for profit, interest, and risk are then subtracted from the end product value to establish the residual value of the standing timber. This appraisal process does not account for the costs of the agency in growing timber and administering timber sales, and the agency does not attempt to maximize profit through marginal adjustments of price and quantity.

In southeast Alaska, the U.S. Forest Service as timber seller faces a duopsony (two buyers) market structure on the timber buying side. Directly or indirectly, two firms control all of the major timber processing capacity in southeast Alaska. Each of these firms owns one pulpmill and two or more cantmill Cants are a form of semiprocessed lumber. Rather than the 2 x 4 found in the U.S. market, cants are on the order of 4 x 4 and larger.

The market structure on the purchaser's side of the timber market in southeast Alaska has evolved over time. The first of the current pulpmills was financed by U.S. firms and built at Ketchikan in 1954 (see figure 1 for mill location). The output is currently high-quality woodpulp suitable for use in the manufacture of rayon and cellophane. At the present time most of this market pulp ends up in the lower 48 states. Recent changes in the ownership structure of the mill may result in more of the output going to Japan and other Pacific Rim markets.

The second pulpmill began operations in 1960 at Sitka and marked the direct entry of Japanese capital into the timber market of southeast Alaska (see figure

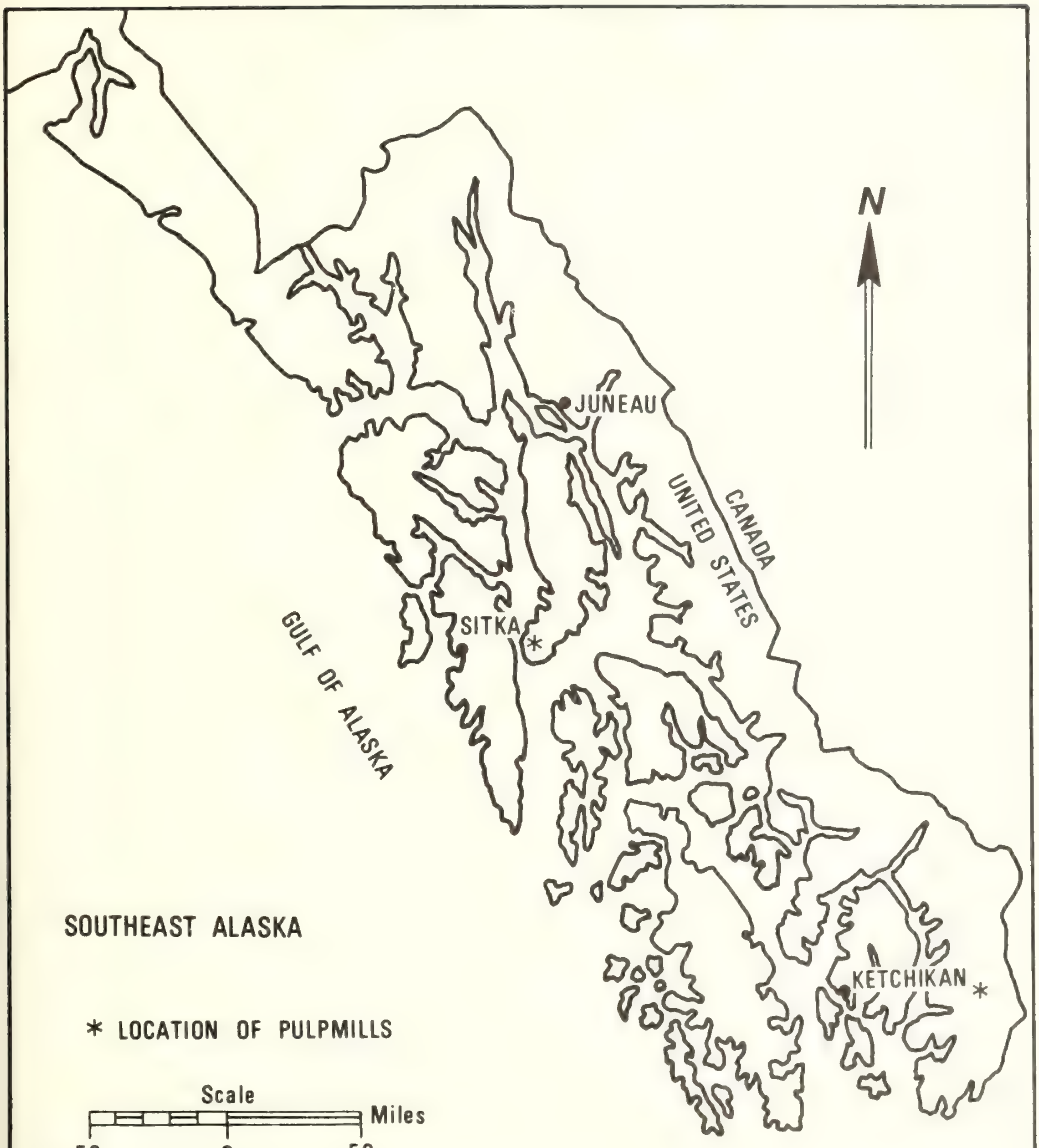


Figure 1.--Map of southeast Alaska east of the 141st meridian.

for mill location). The mill is owned by a consortium of Japanese pulp and paper companies which takes all of the output of the operation. The consortium resells the pulp in Japan.

With the exceptions of small volumes of cedar shipped to Canada and the lower 48 states, output from the cantmills in southeast Alaska goes to Japan. Currently, as has been the case historically, high costs in southeast Alaska and the availability of end products from other competing supply areas have been barriers to the shipment of significant volumes of lumber to markets in the lower 48 states.

As an inducement for the establishment of the pulpmills, the U.S. Forest Service offered to each interested party long-term sales with a 50-year duration. These long-term sales provide over one-half of the timber needed by each of the pulpmills. In addition to volume coming from the two long-term sales, the U.S. Forest Service sells timber in independent sale areas. Currently, the two pulp companies are free to bid on these independent sales.

The geographic separation of the two operations and the stability of timber supply from the two long-term sale areas have led to at least a de facto duopsony situation. If needed, stability of timber supply inherent in the two long-term sale areas gives each of the pulp operations an advantage in bidding for timber on the independent sale areas.

The two pulp companies have discretion over how purchased timber is used. Actual use may not correspond with the end-use assumptions of the Forest Service in the timber appraisal process. Typically, however, higher quality timber is routed to the cantmills and lower quality timber to the pulpmills. There are minimum utilization standards for logging from timber sale areas. These standards are enforced by the Forest Service. The lower quality portion of the timber resource is generally not suited to the manufacture of cants. Small size, rot, and other defects in these logs force their use in the pulpmills. Purchasers of Forest Service timber must have markets for the low-quality portion of the timber sale as well as for the high-quality material. Traditionally, the two pulpmills have provided the only market for low-quality saw logs.

An example of the timber flows in this market is shown in figure 2. The data are for 1974 but are typical of timber flows in recent years. During 1974, a total of 1 324 100 m^3 of the allowable annual cut of 3 624 000 m^3 was not used. Of the timber used, 51.4 percent went to the two pulpmills and the remainder primarily to the cantmills.

Any change in log export policy must work through the timber market depicted in figure 2. To further set the stage for an analysis of the implications of a change in export policy for stumpage revenues and industry stability, we need to look at the current structure of the log market in Japan, the most likely destination for any expanded log export volume from Alaska.

Structure of the Japanese Log Market

Imported logs are used primarily for the manufacture of lumber and plywood (Japan Lumber Journal 1977C, p. 56). Almost all of the imported log volume used for plywood is composed of hardwood species such as lauan. Of the total volume of hardwood log imports amounting to 68.6 million m^3 over the period 1973-75, approximately 58 percent was used for plywood and 42 percent for lumber (Japan

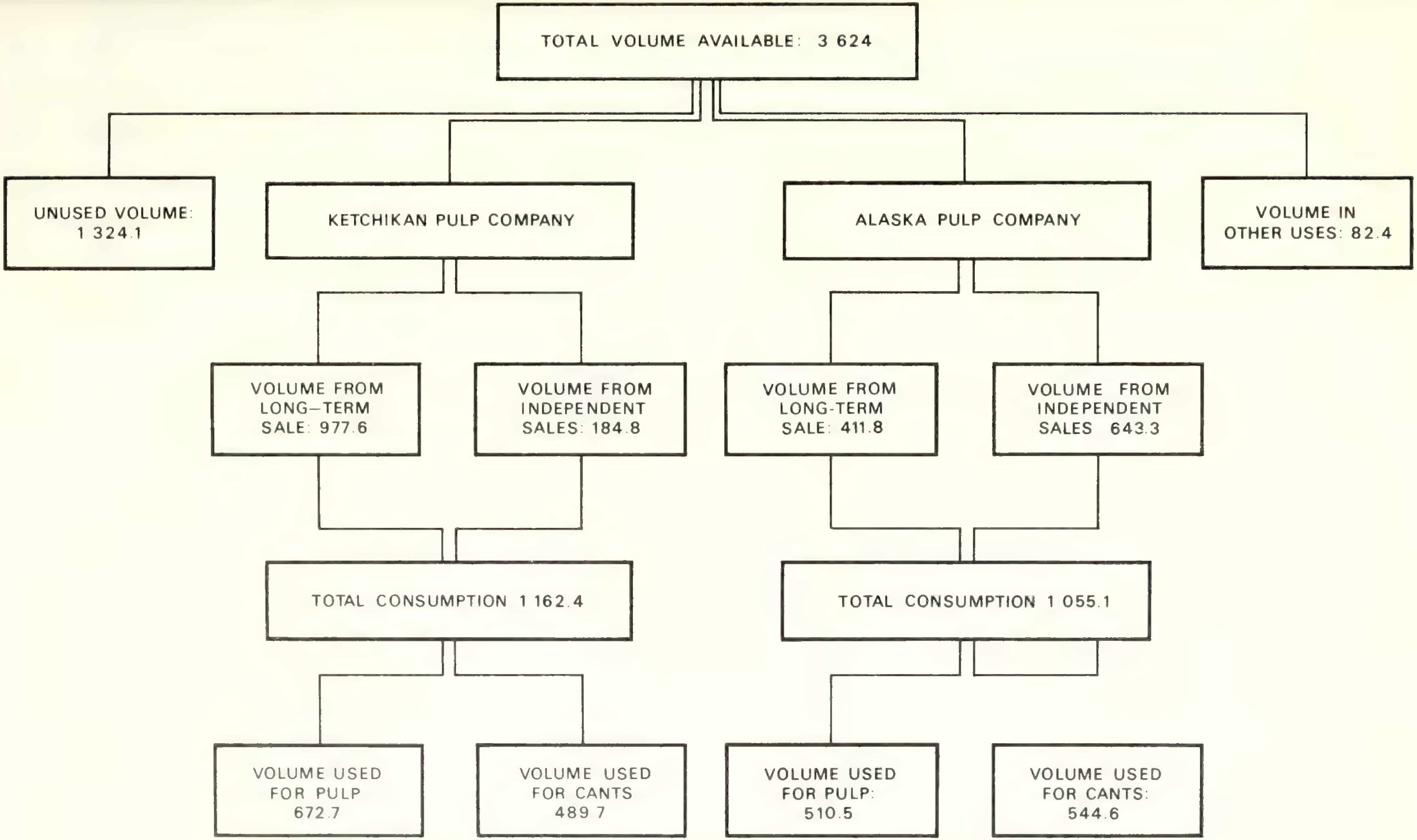

TOTAL VOLUME AVAILABLE: 3 624
UNUSED VOLUME: 1 324.1
KETCHIKAN PULP COMPANY
ALASKA PULP COMPANY
VOLUME IN OTHER USES: 82.4
VOLUME FROM LONG–TERM SALE: 977.6
VOLUME FROM INDEPENDENT SALES: 184.8
VOLUME FROM LONG-TERM SALE: 411.8
VOLUME FROM INDEPENDENT SALES 643.3
TOTAL CONSUMPTION 1 162.4
TOTAL CONSUMPTION 1 055.1
VOLUME USED FOR PULP 672.7
VOLUME USED FOR CANTS 489 7
VOLUME USED FOR PULP: 510.5
VOLUME USED FOR CANTS: 544.6

Figure 2.--Log flows in timber market of southeast Alaska, 1974 (Volumes in 1 000 m^3. USDA Forest Service, Region 10, Juneau, Alaska).

Lumber Journal Inc. 1976). Almost all of the imported softwood log volume is consumed in the manufacture of lumber for use in Japan.

The construction industry accounts for about three-fourths of the consumption of lumber of all species. Other major uses are packaging, 8 percent, and furniture and fixtures, 7 percent. Most of the plywood is used for construction purposes or in the manufacture of furniture. Less than 3 percent of Japan's plywood production is exported (Japan Lumber Journal Inc. 1977C, pp. 58-59).

In addition to log imports, lumber imports--primarily softwoods, are a significant source of construction materials in Japan. By the mid-1970's, annual lumber imports amounted to over 4.5 million m^3, about 8 percent of total lumber consumption (Japan Lumber Journal Inc. 1977B).

Plywood and veneer imports, primarily hardwoods from southeast Asia, represent less than 8 percent of Japan's consumption.

Wood flows in the Japanese lumber and plywood industries are depicted in figure 3 for the year 1976. The data are taken from several sources; and there is a problem in making volume estimates comparable among sources, especially for roundwood logs. The data, however, are believed to be reasonable indicators of the magnitudes of wood flows.

Primary sources of softwood logs are domestic forests, the United States, the Union of Soviet Socialist Republics (U.S.S.R.), New Zealand, and Canada. All of the imported softwood log volume is assumed to go to the lumber processing sector. In addition, 9.6 million m^3 of imported hardwood logs, primarily from the Southeast Asian countries of Malaysia, Indonesia, and the Philippines, and 2.9 million m^3 of hardwood logs from domestic sources are assumed to go to the lumber industry. Almost all of the hardwood log input to the plywood industry is from imported sources.

In 1976, the United States and Canada together accounted for about 77 percent of Japan's lumber imports. The concentration of lumber imports from these two sources probably reflects in part the log export restrictions in the two countries. Roundwood log exports from British Columbia are prohibited unless declared surplus to domestic needs. On the U.S. west coast, roundwood log exports are generally prohibited except for logs originating on State of Washington Department of Natural Resources lands or on private lands. For specific details on these regulations, see Lindell (1978). An exception to the restriction on log exports from National Forest lands in Alaska during the period 1969-76 was western redcedar and Alaska yellow cedar. These relatively minor species could then be exported without restriction. Western redcedar must now be offered to domestic cedar processors prior to export. Alternatively, these logs must receive primary processing according to restrictions applicable to the rest of the National Forest timber volume prior to export.

A share of lumber imports from the United States is in the form of so-called "waney" lumber. This lumber is processed to meet minimum requirements for logs originating on Federal lands--timber purchasers can process round logs into lumber with a maximum thickness of 8-3/4 inches. There are neither length nor width maximums. Typically, the lumber is processed on only two sides, leaving the "wane" on the edges of the lumber. Waney lumber is further processed in Japan. Alaska is the major source of waney lumber in the Japanese market. For

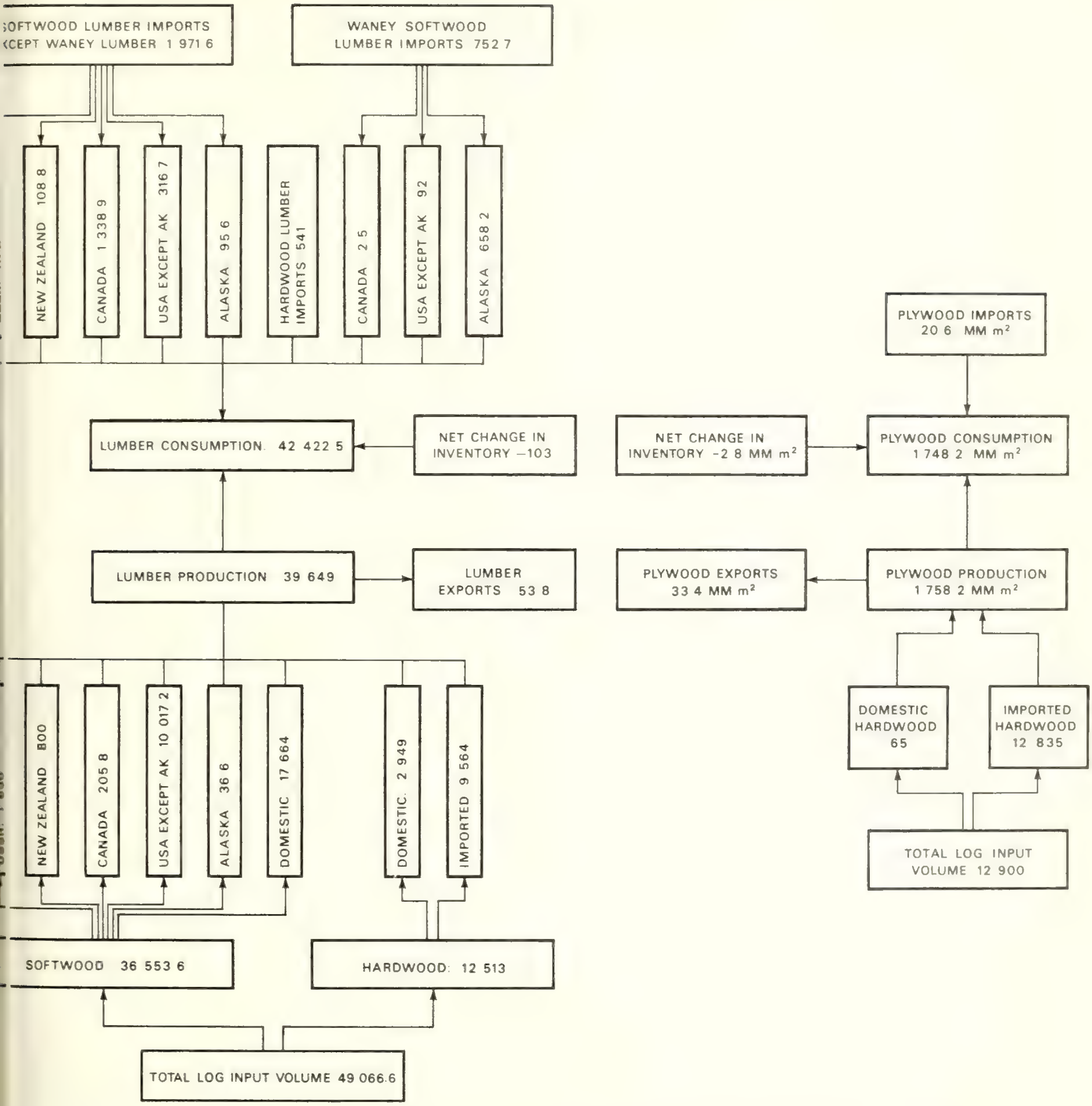


Figure 3.--Material flows in Japan's lumber and plywood industries (Volume in 1 000 m^3 except when noted. Based on data in Forestry Agency of Japan, 1977, and Japan Lumber Journal, Inc., 1977A).

example, Alaska accounted for 87 percent of the 1976 import volume of 752.8 million m^3. Waney lumber amounted to 87 percent of Alaska's shipments of lumber to Japan in 1976 (Japan Lumber Journal Inc. 1977A).

The potential impacts of a change in softwood log export policy in Alaska on prices in Japan depend on the responses of consumers and producers in Japan, timber sale purchasers in southeast Alaska, and producers of competing products in other supply sources. Since existing industry in southeast Alaska grew up with the existing log export restriction, there are no precedents to judge the reactions of producers and consumers in the marketing chain from standing timber to end use in Japan. Scenarios can, however, be constructed based on current timber flow patterns and based on assumptions about the reactions of producers and consumers.

POTENTIAL IMPACTS OF CHANGE

Demand Responses in Japan

The price impacts of any change in log supply from southeast Alaska would depend in part on the elasticity of demand for Alaskan logs and in part on interactions between the price of Alaskan logs and the prices of competing raw materials. Since logs are used as an input in the manufacture of lumber, the demand for logs is derived in part from the demand for the finished product.

There is little in the way of a data base to speculate about the elasticity of demand for lumber in Japan. If we extrapolate from the U.S. experience, the elasticity of demand is probably less than -0.5 and may be on the order of -0.1 or less in the short run (Adams et al. 1977). Reasons for expecting an inelastic demand in Japan as in the U.S. are strong consumer preferences for wood compared with other materials, familiarity of building tradesmen with wood as a construction material, and the relatively small portion of housing costs attributed to wood. Other costs, especially land in Japan, have risen faster than the cost of construction materials.

An inelastic demand for lumber contributes to the expectation of an inelastic demand for imported logs. An additional factor contributing to this expectation is that imported logs are processed near the port-of-entry. Existing distribution channels are not set up to make domestically produced log substitutes for imported logs. The profit motive provides the incentive for log importers to try to operate processing plants near capacity.

In evaluating the potential price impacts of softwood log imports from Alaska, it has been assumed that the elasticity of demand for imported logs is -0.1 at the observed price and quantity in 1976. For the purposes of illustration impacts are also calculated for a demand elasticity of -0.5. Other assumptions, necessary because of a lack of data, include the following:

1. There are no linkages between the demand for imported softwood logs and softwood lumber imports, hardwood log and lumber imports, or domestic softwood and hardwood sources. At least conceptually, the prices of softwood lumber imports, domestic timber, and hardwood log and lumber imports act as shifters on the demand for imported softwood logs. The assumed lack of linkages among raw material sources abstracts from these interactions and probably lends a bias in the direction of high price impacts.

2. Japanese importers have no species preference for imported softwood logs. This assumption abstracts from the price premiums paid for Douglas-fir, western hemlock and other species. The assumed lack of consumer preference probably lends a bias towards lower price impacts than would actually be realized through a change in export policy.

Supply Responses

Because interactions of demand for imported softwood logs and other sources of timber are not considered in the analysis, the supplies of raw materials from imported softwood lumber sources, domestic sources, and imported hardwood sources are assumed to be unresponsive to changes in softwood log import prices. We still have to consider the price responsiveness of softwood log supplies from the U.S.S.R., New Zealand, Canada, the U.S. west coast, and Alaska.

Softwood log export volume from the U.S.S.R. is probably price inelastic. The need for foreign exchange is a driving force behind this country's export activities. Development plans in eastern Siberia are keyed on a population base dependent on natural resource management and extraction. For the purposes of this analysis, supply from the U.S.S.R. is assumed to be perfectly inelastic with respect to price at the price and quantity observed in 1976.

In New Zealand, the log export market provides an outlet for timber surplus to domestic needs. This would probably tend to make export volume price inelastic over the range of volume considered in this analysis. In addition, New Zealand is moving in the direction of promoting the export of finished products rather than logs (Ferguson and Parks 1976). This direction is an argument in favor of inelastic supply: existing log exporters would probably be motivated to continue log exports prior to the change in direction on trade policy. Softwood log export supply from New Zealand is assumed to be perfectly inelastic at the price and quantity observed in 1976.

British Columbia, the Canadian source of logs in the Japanese market, has a long-standing log export restriction (Lindell 1977). Log exports under this restriction are probably more responsive to market conditions in British Columbia than in the Japanese log market: logs must be declared surplus to domestic needs prior to being eligible for the export market. For the purposes of this analysis, Canadian log exports are considered to be perfectly inelastic at the observed price and quantity in 1976.

Since most of the log exports from Washington, Oregon, and California are from private lands, the profit motivation for log owners tends to make export volume responsive to changes in prices. Even for this source of logs, however, there are arguments in favor of an inelastic supply. Logs are typically exported according to the terms of multiyear contracts which feature annual openings for negotiations on both contracted volume and price. A further argument for an inelastic supply over the range of volumes considered in this analysis is that logs from private lands may be of a species not needed in the owner's operations or may be volume surplus to the owner's needs. Additionally, the export market pays a premium for needed logs. Even if log prices were lowered somewhat, there would still be an incentive to sell these logs in the export rather than the domestic market. For the purposes of this analysis, it has been assumed that the elasticity of supply for logs coming from Washington, Oregon, and California is equal to 0.5 at the observed price and volume in 1976.

The elasticity of supply for additional log volumes from Alaska is assumed to be 0.5. There is little precedent to judge the price responsiveness of this supply, however. Higher prices would make more timber accessible; but the timber appraisal process used by the U.S. Forest Service would capture a share of high revenues, reducing the incentive to export logs.

The structure of demand and supply which has been postulated for softwood logs imported into Japan probably results in an estimate of the maximum price impacts which could be associated with expanded log exports from the Tongass National Forest. Despite this shortcoming, the analysis is useful for policy analysis in that it places an upper limit on price impacts to be associated with a change in policy.

The Conceptual Model

The conceptual model used to illustrate the potential price impacts of a shift in Alaskan log supply is shown in figure 4. The price and volume data used in the illustration are for 1976. Supplies from the U.S.S.R., New Zealand, and Canada are assumed to be perfectly inelastic with respect to price at the recorded volumes for 1976. Supplies from the west coast states of Washington, Oregon, and California, and Alaska are assumed to have an elasticity of 0.5 at the observed price and quantity for 1976. All imported logs are assumed to be homogeneous with no distinctions for species and log grades.

Linear supply schedules are assumed and calculated as:

$$\frac{q_i}{p} e_i = \frac{\Delta q_i}{\Delta p}$$

$$q_i = A + \frac{\Delta q_i}{\Delta p} (p) \qquad ;$$

where

e_i = elasticity of supply for logs from source i,
q_i = quantity of imports from source i in 1976, and
p = average price of imported logs from all sources in 1976.

The demand schedule in figure 4 is based on an assumed elasticity of -0.1 at the observed price and quantity for all imported softwood log volume in 1976. The schedule is assumed linear and calculated as:

$$\frac{q}{p} e = \frac{\Delta q}{\Delta p}$$

$$q = A + \frac{\Delta q}{\Delta p} (p) \qquad ;$$

where

q = imported softwood log volume in 1976,
p = average price of imported softwood log volume in 1976, and
e = elasticity of demand.

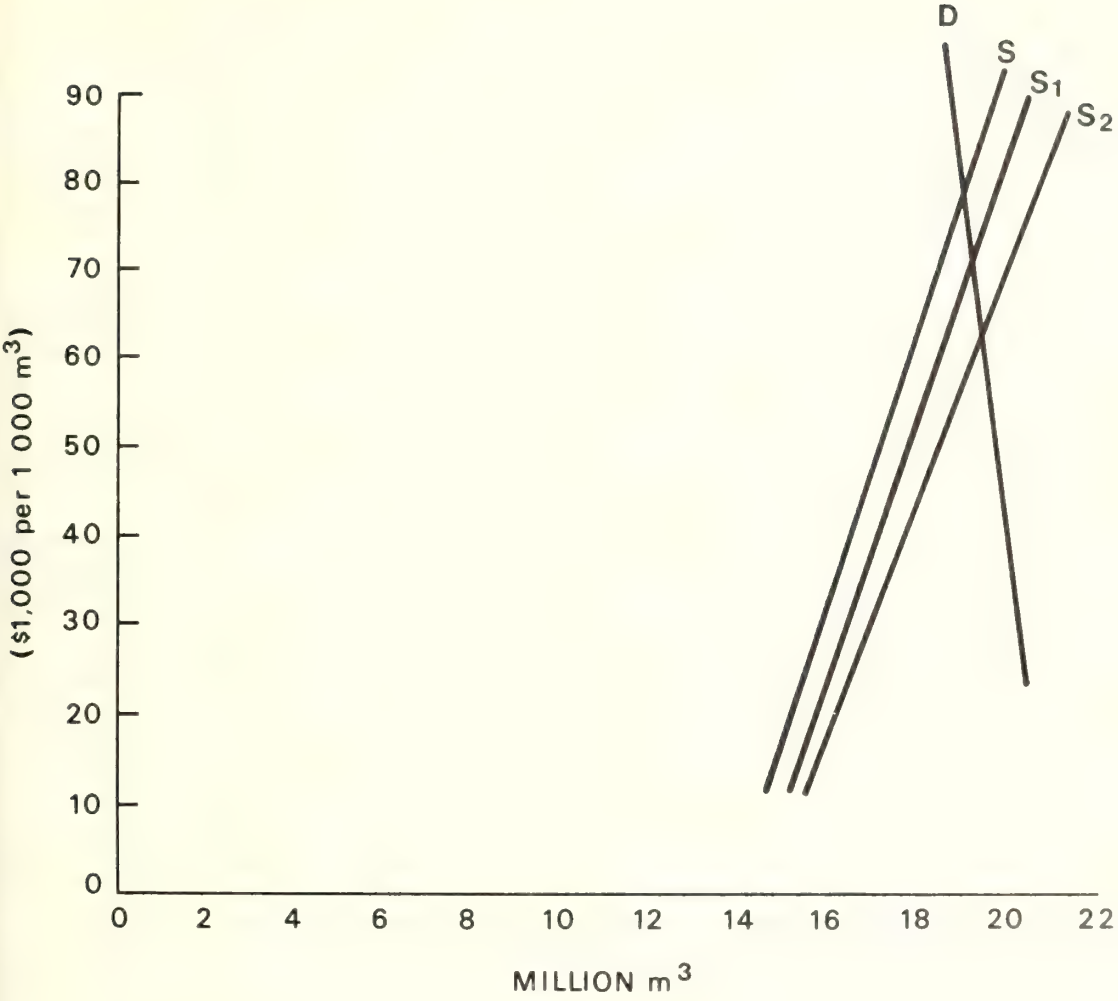


Figure 4.--Demand for imported softwood logs in Japan and supply of imported softwood logs under alternative export policies on the Tongass National Forest (demand represented by "D" in figure. "S" is total softwood supply under current export policy on the Tongass National Forest).

The analysis was also carried through with an assumed elasticity of -0.5.

Two possible supply shifts from Alaska at the observed price and quantity in 1976 were postulated: 679 500 m^3 and 1 585 500 m^3 (S_1 and S_2 respectively in figure 4). The supply elasticity for Alaskan exports after each supply shift is assumed to be 0.5. Supply schedules are assumed linear and calculated as above.

The supply shift of 679 500 m^3 is based on a change in policy to partially ease the current export restriction. Existing industry in southeast Alaska claims to need about 2 944 500 m^3 of timber to maintain existing operations. Since the allowable annual cut is 3 624 000 m^3, this leaves 679 500 m^3 which can be viewed as being surplus to domestic needs. Under the terms of this policy change, the Tongass National Forest would in effect have a 679 500 m^3 export quota.

The assumed supply shift of 1 585 500 m^3 is based on a complete removal of the log export restriction on the Tongass National Forest. The Japanese log importers generally prefer No. 2 and better saw logs--average quality and better (Darr 1975). About 1 585 500 m^3 of the 3 624 000 m^3 allowable annual cut meets this quality criterion.[1] In the analysis, Alaskan producers are assumed to be willing and able to sell the additional 1 585 500 m^3 at the price observed in Japan in 1976.

For both supply shifts, the analysis assumes that the two export levels are feasible from the standpoint of the Alaskan timber market. Possible impacts on this market are discussed later. The analysis also abstracts from possible problems related to the availability of factors of production such as logging crews and shipping capacity.

Price Impacts in Japan

An increase in supply of 679 500 m^3 of softwood logs from Alaska would reduce the price in Japan from $78,150 per thousand m^3 to $70,833 if the elasticity of demand is assumed to be -0.1 and to $74,565 if the elasticity of demand is assumed to be -0.5; this amounts to percentage declines of 9.4 and 4.6, respectively. For a supply increase of 1 585 500 m^3, the percentage decline in price is 20.6 percent if the elasticity of demand is -0.1 and 10.4 percent if the elasticity of demand is -0.5.

The price declines would range from $3,585 to $16,066 per thousand m^3 depending on the elasticity of demand (e_D) and the amount of the supply shift:

Supply shift and e_D	Dollars per 1 000 m^3
679 500 m^3	
$e_D = -0.1$	7,317
$e_D = -0.5$	3,585
1 585 500 m^3	
$e_D = -0.1$	16,066
$e_D = -0.5$	8,115

At the lower prices, the increase in supply is less than the assumed increment in Alaskan exports at the 1976 price. The supply offsets occur from Alaska and the other west coast States:

---

[1] Source: USDA Forest Service, Region 10, Juneau, Alaska.

Supply increase and e_D	Supply offset due to lower price (1 000 m^3)	
	Alaska	Washington, Oregon, and California
679 500 m^3		
$e_D = -0.1$	33.7	468.8
$e_D = -0.5$	16.8	229.6
1 585 500 m^3		
$e_D = -0.1$	167.1	1 029.6
$e_D = -0.5$	84.4	520

Impacts in Alaskan Timber Market

If all of the price decline in Japan is passed along to the stumpage market in southeast Alaska, timber appraisals for U.S. Forest Service sales would be as follows:[2]

Assumed end product:	Stumpage price (dollars per 1 000 m^3)
Log exports:	
Current policy	26,472.46
Supply increase of 679 500 m^3	
$e_D = -0.1$	20,033.15
$e_D = -0.5$	23,317.93
Supply increase of 1 585 500 m^3	
$e_D = -0.1$	12,333.36
$e_D = -0.5$	19,331.17
Cants and chips	22,847.73
Pulp	5,033.12

The derived stumpage price for log exports without taking into account market responses ($26,274.46) is higher than either the residual price for cants and chips appraised to the Japanese market or the value of stumpage appraised to the pulp market. After accounting for market responses, only the stumpage value resulting from a 679 500 m^3 increase in supply with a demand elasticity of -0.5 exceeds the value of stumpage currently appraised to the Japanese cant and chip market.

---

[2] Darr, David, et al. 1977. An Overview of Some Economic Options for Southeast Alaska. 219 p., illus (Unpublished).

In the above analysis, the assumption has been made that with a 679 500 m^3 quota for the log export market, the existing cantmills and pulpmills could continue operations as is. This assumption ignores the realities of timber quality differentials. If we assume that the distribution of log grades in the timber inventory is equal to the distribution of log grades in an allowable annual cut level of 3 624 000 m^3, the distribution by log grade would be as follows:

Log grade	Percent of volume	m^3
Select and peeler	1.9	68 856
No. 1	8.1	293 544
No. 2	33.0	1 195 920
No. 3	52.9	1 917 096
Cull	4.1	148 584
Total	100.00	3 624 000

Total volume classed as select and peeler, No. 1 and No. 2 equals 1 558 320 m The active cant producers in southeast Alaska have a capacity of about 1 608 150 m Actual consumption in 1974 equaled 1 336 250 m^3. These cantmills consume primarily No. 2 and better saw logs: in 1975, 87.5 percent of the volume was of this quality.[3]

If the cantmills operating at capacity require a log mix of 87.5-percent No. 2 and better quality, these mills need 1 408 800 m^3 to maintain capacity operation. Less than 1 408 800 m^3 of No. 2 and better saw log volume would be left to the cantmills under each of the export supply responses portrayed in this analysis:

Supply increase and e_D	Volume exported	Volume remaining for cantmills
	- - - - - - - - 1 000 m^3	- - - - - - - -
679 500 m^3		
$e_D = -0.1$	682.4	875.9
$e_D = -0.5$	699.6	858.7
1 585 500 m^3		
$e_D = -0.1$	1 455	103.3
$e_D = -0.5$	1 537.7	20.6

The cantmill industry might adjust to a lower quality log mix. Alternatively, some cantmill capacity might be closed down under either a partial or complete easing of the export restriction.

A further reason for expecting cantmill closure even under a partial easing of the export restriction is that waney lumber or cants are processed to meet the terms of the current export restriction. If 679 500 m^3 of No. 2 and better saw logs could be exported, Japanese purchasers may substitute logs for cants. In 1976, the volume of waney lumber exports from Alaska to Japan equaled 915 100 log equivalent. If logs were substituted on a one-to-one basis, only 235 600 m^3 need be taken in the form of waney cants. A volume of 235 600 m^3 is equivalent to the annual log input of one of the larger cantmills now in operation.

---

[3] Source: USDA Forest Service, Region 10, Juneau, Alaska.

The volume of No. 2 and better saw logs remaining for the cantmills after a supply increase of 1 585 500 m^3 is not adequate to support a cantmill if the elasticity of demand is -0.5. A volume of 103 000 m^3 is only marginal as a source of raw material for a cantmill.

Full use of an annual allowable cut of 3 624 000 m^3 either under the terms of an export quota of 679 500 m^3 or a complete lifting of the export restriction would require utilization of No. 3 grade saw logs and cull logs as well as high quality material. The two pulpmills have a capacity totaling 1 585 500 m^3 of log input. The combined cut for No. 3 saw logs and cull material for an annual allowable cut of 3 624 000 m^3 equals 2 065 680 m^3. Historically, the two pulp operations have been the only market for this low quality material. The excess volume of 480 180 m^3 might be used through development of a chip export market, through adjustment of cantmills to a lower quality log mix, or through expansion of the pulpmills. Because of the need to meet utilization standards, the excess volume of lower quality material might prohibit the sale of timber if the prospective purchaser could not find an outlet.

In either a partial or complete lifting of the export restriction, one or both of the pulpmills are the likely purchasers of the export sales. The established positions of these mills in the timber market of southeast Alaska and the end product market of Japan coupled with the timber supply stability inherent in the long-term sales give them formidable advantages in bidding against outsiders. Each of the pulp operations as purchaser of timber sales eligible for the export market would be in a position to judge the relative profitability of routing logs to the export market, to the cantmills, or to the pulpmill.

Assuming that the two pulp operations purchased any sales made available to the log export market, there are two primary reasons for expecting them to continue operation of the pulpmills. First, the timber sale purchaser would need an outlet for the low quality material. Currently and historically, this outlet has been the two pulpmills. Second, the high-fixed costs of pulpmill manufacture act as incentives for keeping the pulpmills in operation. Depending on the accounting procedure, fixed costs of pulp manufacture may amount to as much as 50 percent of total costs. These costs would continue even if the pulpmills were shut down. If "rational," the owner of an operating pulpmill would tend to look upon recovery of fixed costs as profits.

IMPLICATIONS OF ANALYSIS OF IMPACTS

Stumpage Revenues

The log export market offers potential for increasing stumpage revenues. This potential, however, is constrained by the possible reduction in prices caused by an expansion of supply in the log export market. The results of this study indicate that an expansion of supply by 679 500 m^3 would reduce potential stumpage revenues to about the level realized if timber is appraised at the present volume level to the cant and chip market in Japan. An expansion of supply by 1 585 500 m^3 would reduce potential stumpage revenues well below the potential from the cant and chip market. Even for the larger supply increase, however, stumpage revenues from the log export market would exceed revenues from sales to pulp as the end use.

Industry Stability

If the Japanese followed current practice and took primarily No. 2 and better saw logs after an easing of the export restriction, the existing cant industry in southeast Alaska would have to curtail operations or adjust to a lower quality log mix. Adjustment by the cantmill industry would be necessary even under the terms of 679 500 m^3 export quota which seemingly protects the stability of existing industry. The necessary adjustments would be accentuated by a complete easing of the restriction.

Relation to Previous Work

Swenson (1971), and the Public Land Law Review Commission (1969) both recommended easing the export restriction to the extent of logs surplus to the needs of existing industry. This recommendation was based in part on the expectation of higher stumpage revenues and in part on the presumed stability of existing industry. Neither study considered the details of possible market responses in the timber market of southeast Alaska and the end product market of Japan. Missing were considerations of timber quality relative to end use and of the elasticities of demand and supply in Japan.

The methodology used to specify the model of Japanese forest products market is a crude analytical tool in many respects. A general equilibrium econometrics model is perhaps a better approach from a conceptual standpoint. In U.S. literature, McKillop's (1973) work remains the only attempt at this approach. Although a model could be postulated to simulate demand and supply interactions, trade flows are influenced by a variety of factors such as tariff and nontariff trade barriers and changes in domestic policies unrelated to the prices or quantities of wood flows. Aside from the conceptual problems of modeling these nonmarket forces, there are formidable data problems in estimating the flow of an intermediate product, roundwood, among producers and consumers. The data problem for specifying a model of Alaskan log exports is confounded by a lack of precedent by which to judge the reactions of producers and consumers.

Export Policy

An easing of the export restriction provides an additional outlet for the higher quality portion of the Alaskan timber resource. The advantage of logs over cants in terms of stumpage revenues decreases as log export volume increases. The trade-off associated with the potential of higher stumpage revenues from the log export market is the potential for disruption of the stability of existing industry--especially cantmill operations. An expansion of the use of higher quality material carries with it the need to utilize coincidental lower quality timber. In considering any change in export policy, the Forest Service in southeast Alaska has the problem of weighing this trade-off with other objectives which determine the mix of the agency's responses to competing demands.

From a national perspective, the potential for increased stumpage revenues in southeast Alaska might be realized at the expense of decreased log export revenues in Washington, Oregon, and California--price reductions in the Japanese market feed back to all log supply areas. In 1976, the value of log exports to Japan from the three west coast States totaled $764.5 million (Ruderman 1977). Price declines associated with the supply increases protrayed in this analysis ranged from 4.6 to 20.6 percent. These declines correspond with a range in potential revenue reduction of $32.2 million to $157.5 million for exporters in Washington, Oregon, and California. The distributional aspects of revenue gains and losses might be a deciding factor in any change in export policy in southeast Alaska.

The status of National Forest land in southeast Alaska is confused by the possible extent of land transfers to the State of Alaska and to Native corporations. Undoubtedly, some land and timber will be transferred from the Federal Government to local organizations. This will reduce the allowable annual cut on the Tongass National Forest and add a constraint on the flexibility of the U.S. Forest Service to change the export policy to fulfill the agency's goals and objectives. Future timber management policies on lands selected by Native corporations are not clear. The export of roundwood logs is one option being considered. Maximization of stumpage revenues is one possible objective of timber management on these lands. The potential price impacts of increased log export supplies discussed in this paper for National Forest lands applies as well to increased supplies from Native lands.

LITERATURE CITED

Adams, Darius M., Richard W. Haynes, and David R. Darr.
1977. Alternative techniques for analysis of price effects of changes in National Forest timber flows: A background report. USDA For. Serv. Gen. Tech. Rep. PNW-60, 18 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Darr, David R.
1975. Softwood log exports and the value and employment issues. USDA For. Serv. Res. Pap. PNW-200, 13 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Ferguson, S. I., and D. E. Parkes.
1976. International trade in forest products--an Australian perspective. Australian Government Publishing Serv., Canbena.

Forestry Agency of Japan.
1977. Lumber Market Monthly Report. (Published monthly in Japanese). Tokyo.

Hutchison, O. K.
1968. Alaska's Forest Resource. USDA For. Serv. Res. Bull. PNW-19, 74 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Japan Lumber Journal, Inc.
1976. Demand actuals and estimates of southsea logs. Jpn. Lumber J. 17(7):3. Tokyo.

Japan Lumber Journal, Inc.
1977A. American timber imports by supply regions. Jpn. Lumber J. 18(4):3. Tokyo.

Japan Lumber Journal, Inc.
1977B. Demand and supply of timber. Jpn. Lumber J. 18(6):3. Tokyo.

Japan Lumber Journal, Inc.
1977C. White paper on Japan's forest industries, 1977. Tokyo.

Lindell, Gary R.
1978. Log export restrictions of the western states and British Columbia. USDA For. Serv. Gen. Tech. Rep. PNW-63, 14 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

McKillop, William.
1973. Structural analysis of Japanese-North American trade in forest products. For. Sci. 19(1):63-74.

Public Land Law Review Commission.
1969. Federal land laws and policies in Alaska, Vol. II. U.S. Dep. Comm., Nat. Tech. Info. Serv., PB 195-295.

Ruderman, Florence K.
1977. Production, prices, employment, and trade in Northwest forest industries. Published quarterly. USDA For. Serv. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Swenson, N. P.
1971. A proposal for a two-price system for selling Alaskan timber. Land Econ. 47(May):181-185.

GPO 986-366

Darr, David R.
1978. Potential impacts of easing the log export restriction on the Tongass National Forest. USDA For. Serv. Resour. Bull. PNW-77, 18 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oregon.

The potential of higher revenues in the log export market is constrained by possible reductions in prices associated with expanded supplies in the Japanese log market. Expanded log exports from the Tongass National Forest might force adjustments by existing cantmills, even under a partial easing of the export restriction.

KEYWORDS: Import/export (forest products), trade policy (international), market prices, supply/demand (forest products), Alaska (Tongass National Forest).

Darr, David R.
1978. Potential impacts of easing the log export restriction on the Tongass National Forest. USDA For. Serv. Resour. Bull. PNW-77, 18 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oregon.

The potential of higher revenues in the log export market is constrained by possible reductions in prices associated with expanded supplies in the Japanese log market. Expanded log exports from the Tongass National Forest might force adjustments by existing cantmills, even under a partial easing of the export restriction.

KEYWORDS: Import/export (forest products), trade policy (international), market prices, supply/demand (forest products), Alaska (Tongass National Forest).

Darr, David R.
1978. Potential impacts of easing the log export restriction on the Tongass National Forest. USDA For. Serv. Resour. Bull. PNW-77, 18 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland. Oregon.

The potential of higher revenues in the log export market is constrained by possible reductions in prices associated with expanded supplies in the Japanese log market. Expanded log exports from the Tongass National Forest might force adjustments by existing cantmills, even under a partial easing of the export restriction.

KEYWORDS: Import/export (forest products), trade policy (international), market prices, supply/demand (forest products), Alaska (Tongass National Forest).

Darr, David R.
1978. Potential impacts of easing the log export restriction on the Tongass National Forest. USDA For. Serv. Resour. Bull. PNW-77, 18 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oregon.

The potential of higher revenues in the log export market is constrained by possible reductions in prices associated with expanded supplies in the Japanese log market. Expanded log exports from the Tongass National Forest might force adjustments by existing cantmills, even under a partial easing of the export restriction.

KEYWORDS: Import/export (forest products), trade policy (international), market prices, supply/demand (forest products), Alaska (Tongass National Forest).

The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Developing and evaluating alternative methods and levels of resource management.
3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research are made available promptly. Project headquarters are at:

Fairbanks, Alaska
Juneau, Alaska
Bend, Oregon
Corvallis, Oregon
La Grande, Oregon
Portland, Oregon
Olympia, Washington
Seattle, Washington
Wenatchee, Washington

Mailing address: Pacific Northwest Forest and Range
Experiment Station
P.O. Box 3141
Portland, Oregon 97208

The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

The U.S. Department of Agriculture is an Equal Opportunity Employer. Applicants for all Department programs will be given equal consideration without regard to race, color, sex or national origin.

O; PNW-78

USDA Forest Service
Resource Bulletin PNW-78

April 1978

1976 OREGON TIMBER HARVEST

by

J. D. Lloyd, Jr., *Supervisory Forester*

The 1976 Oregon timber harvest of 8.15 billion board feet ended a 3-year decline. The cut was 783 million board feet (10.6 percent) above the 1975 harvest. The western Oregon harvest rose 812 million board feet (15 percent) while eastern Oregon declined 29 million board feet (15 percent). The proportion of total harvest which comes from eastern Oregon has gradually increased from about 12 percent in the early 1950's to about 24 percent in recent years. After falling below the private cut in 1975, harvest on public lands accounted for 56 percent of the total in 1976.

Logging on public lands gained 888 million board feet in western Oregon and 114 million board feet in eastern Oregon. Harvest increased on Bureau of Land Management (BLM) lands 456 million board feet (73 percent) and on National Forests 513 million board feet (19 percent). Indian land was the only nonprivate owner group which decreased in 1976; log sales fell 15 million board feet.

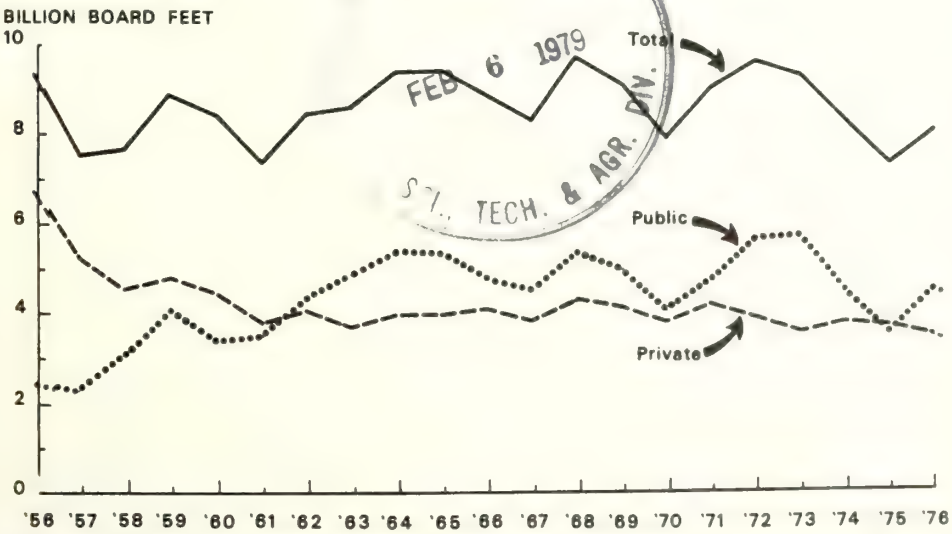
The private log harvest declined 76 million board feet in western Oregon and 144 million board feet in eastern Oregon. Nearly all the loss was on forest industry lands. Other private owners harvested 63 million board feet more than 1975 in the western half-State, but decreased 11 million board feet in the eastern half.

In 1952, Douglas County assumed the lead from Lane County as the top log-producing county in the State. Except for 2 years, it has kept this position. For the last 25 years, these two counties combined have produced 35-45 percent of the harvest for the western half-State area, and 30-35 percent of the harvest for the total State.

Volume of timber sold on National Forest, BLM, and State lands declined 22 percent to 3.8 billion board feet. This occurred despite rising prices. Prices rose $11.10 in western Oregon to $147.73 and $15.19 in eastern Oregon to $50.92.

UNIVERSITY LIBRARY
FEB 6 1979
SCI. TECH. & AGR. DIV.

OREGON TIMBER HARVEST 1956–76



PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION

Forest Service
U.S. Department of Agriculture

P.O. Box 3141
Portland, Oregon 97208

Timber harvest by ownership in the State of Oregon, 1976[1]

(In thousands of board feet, Scribner log scale)

Half-State and county	Private[2]			Bureau of Land Management[3]	National Forest[4]	Indian[5]	Other Federal[2]	State[6]	Other public[2]	Total
	Forest industry	Other	Total							
Western Oregon:										
Benton	47,568	8,577	56,145	25,081	4,768	--	--	5,750	3	91,747
Clackamas	105,066	14,200	119,266	29,465	214,111	--	--	1,192	711	364,745
Clatsop	202,887	6,646	209,533	--	--	--	179	69,292	57	279,061
Columbia	93,001	9,228	102,229	42	--	--	--	2,880	1,153	106,304
Coos	266,556	19,178	285,734	145,545	39,612	--	1,316	23,835	5,023	501,065
Curry	46,862	22,789	69,651	10,468	75,510	--	--	330	1,019	156,978
Douglas	615,499	31,075	646,574	343,908	302,409	--	--	14,380	1,033	1,308,304
Hood River	3,003	1,075	4,078	--	41,798	--	--	--	917	46,793
Jackson	117,996	10,280	128,276	106,426	147,153	--	3,461	964	470	386,750
Josephine	5,006	9,036	14,042	80,482	51,436	--	--	13	2,653	148,626
Lane	392,246	48,122	440,368	160,885	566,774	--	123	13,319	35	1,181,504
Lincoln	147,264	7,634	154,898	9,467	117,977	--	--	11,559	961	294,862
Linn	376,928	82,009	458,937	48,556	243,781	--	--	10,388	--	767,662
Marion	16,411	8,112	24,523	14,756	37,913	--	--	8,918	90	86,200
Multomah	3,537	2,160	5,697	--	19,478	--	--	--	335	25,510
Polk	57,766	7,976	65,742	13,000	--	--	241	7,314	199	86,496
Tillamook	134,860	6,323	141,183	49,211	47,768	--	--	24,459	160	262,781
Washington	10,123	10,631	20,754	--	--	--	--	792	241	21,787
Yamhill	34,568	7,300	41,868	15,221	378	--	--	--	4,830	62,297
Total	2,677,147	312,351	2,989,498	1,052,513	1,916,866	--	5,320	195,385	19,890	6,179,472
Eastern Oregon:										
Baker	1,317	7,894	9,211	378	80,360	--	--	--	--	89,949
Crook	8,370	1,061	9,431	87	86,893	--	--	--	--	96,411
Deschutes	41,443	13	41,456	2,229	91,730	--	--	--	--	135,415
Gilliam	--	--	--	--	--	--	--	--	--	--
Grant	14,578	10,406	24,984	511	209,561	--	--	--	--	235,056
Harney	--	2,204	2,204	--	81,043	--	--	--	--	83,247
Jefferson	12,885	--	12,885	--	53,862	33,205	--	--	--	99,952
Klamath	126,981	32,735	159,716	17,041	207,844	--	--	8,028	--	392,629
Lake	160,936	4,372	165,308	20	146,339	--	--	--	--	311,667
Malheur	--	559	559	--	--	--	--	--	--	559
Morrow	16,576	2,277	18,853	--	34,792	--	--	--	--	53,645
Sherman	--	--	--	--	--	--	--	--	--	--
Umatilla	6,605	6,351	12,956	4,776	78,316	--	--	--	--	96,048
Union	43,801	14,139	57,940	387	70,495	--	--	28	--	128,850
Wallowa	8,158	12,021	20,179	254	45,309	--	--	--	--	65,742
Wasco	1,615	2,792	4,407	--	59,642	74,353	--	--	--	138,402
Wheeler	26,742	5,083	31,825	3,720	10,922	--	--	--	--	46,467
Total	470,007	101,907	571,914	29,403	1,257,108	107,558	--	8,056	--	1,974,039
Total Oregon	3,147,154	414,258	3,561,412	1,081,916	3,173,974	107,558	5,320	203,441	19,890	8,153,511

---

[1] Includes volume removed as logs and poles and piling but not volume removed from woodcutting operations.

[2] Compiled by Oregon State Department of Revenue.

[3] Compiled by U.S. Bureau of Land Management. Beginning with 1974, volumes for western Oregon are adjusted from short log to long log by a factor of 0.89.

[4] Compiled by U.S. Forest Service, Region 6.

[5] Compiled by U.S. Bureau of Indian Affairs.

[6] Compiled by State Forester.

Prepared by Renewable Resources Evaluation Work Unit, Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Portland, Oregon.

Keywords: Production statistics, Oregon.

USDA Forest Service Resource Bulletin PNW-79
1978

CLEMSON UNIVERSITY LIBRARY
DEC 11 1978
SCI., TECH. & AGR. DIV.

OREGON´S Forest Products Industry 1976

James O. Howard
Bruce A. Hiserote

Pacific Northwest Forest and Range Experiment Station
U.S. Department of Agriculture
Forest Service
Portland, Oregon

Highlights

INDUSTRY CHARACTERISTICS

- Total number of mills in 1976 was 498:

Type of mill	Number
Sawmills	243
Veneer and plywood	132
Pulp	17
Board	23
Shake and shingle	46
Log export	28
Post, pole, and piling	9

- Lane County led all others with 92 mills with 18 percent of the State total.
- The 88 largest sawmills had 64 percent of total sawmill capacity.
- Only 58 burners operated in the State in 1976.

WOOD CONSUMPTION

- A total of 9,339 million board feet of logs were consumed.
- Pulp and board industry consumed 7.3 million tons of mill residues and off-site roundwood chips.
- Leading counties in roundwood consumption were:

	Million board feet
Lane	1,776
Douglas	1,124
Coos	798
Klamath	570

- Over 31 percent of logs were from young-growth timber.
- Public lands were the source for 56 percent of the log consumption; National Forests provided the largest share, 37 percent.
- Log consumption by industry:

	Percent
Sawmills	57.8
Veneer and plywood	35.4
Log export	5.3
Pulp and board	.8
Shake and shingle	.4
Post, pole, and piling	.3

MILL RESIDUES

- A total of 15.4 million tons of residues were generated:

Type of mill	Tons (dry weight) of residue
Sawmills	8,645,000
Veneer and plywood	6,693,000
Shake and shingle	45,000

- 79 percent of the residue was wood, 21 percent was bark.
- Almost 98 percent of wood residue was used, and 92 percent of bark was used.
- 73 percent of wood residue went to pulp and board industries, 16 percent was used for fuel.
- 76 percent of bark was used for fuel, 15 percent was used for miscellaneous purposes.

OREGON'S FOREST INDUSTRY

REFERENCE ABSTRACT

Howard, James O., and Bruce A. Hiserote.
1978. Oregon's forest products industry, 1976. USDA For. Serv. Resour. Bull. PNW-79, 102 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report presents the findings of a 100-percent canvas of the primary forest products industry in Oregon for 1976. Tabular presentation includes characteristics of the industry log consumption and disposition of mill residues. Accompanying the tables is a descriptive analysis of conditions and trends in the industry.

KEYWORDS: Forest products industry, wood utilization, wood waste utilization, mill operations/ products, Oregon.

RESEARCH SUMMARY

Resource Bulletin PNW-79

1978

This report presents the findings of a 100-percent survey of the forest products industry in Oregon. Data were collected by questionnaire for each mill that operated during 1976. The survey included the following sectors: lumber; veneer and plywood; pulp and board; shake and shingle; export; and post, pole, and piling.

There were 498 separate operations identified in the survey, that used a total of 9.3 billion board feet of logs in 1976. The lumber and veneer and plywood sectors were the major users, accounting for 58 percent and 35 percent respectively. In addition the pulp and board industry used about 7.3 million tons of wood fiber, 90 percent of it in the form of mill residues. The industry as a whole generated some 15.4 million tons of residual materials, of which only 3 percent were not used.

Data from the survey are presented in tabular form and significant features of the industry and its raw material usage are discussed in the text. Also included in the text are some comparisons of the current survey with comparable data for 1968 and 1972.

Preface

This report presents the results of a survey of the primary wood processing industry in Oregon for 1972. This survey identifies the raw material inputs and characteristics of the forest products industry. Data are shown separately for the following industries: lumber, veneer and plywood, pulp and board, shake and shingle, post, pole and piling, and export.

Similar surveys were produced in 1968 in cooperation with the Oregon State Department of Forestry and in 1972 with Oregon State University.

Data for the survey were obtained from a 100-percent mail and telephone canvas of all primary wood processing firms in the State. The survey was conducted in 1977. Industry contacts for the survey were based on lists from previous surveys, up-dated using assistance of the Oregon Division of Employment, various directories of the forest products industry, and from information passed on by individual mill owners.

Reliability of the data presented in this report is considered to be high, since the survey was a 100-percent canvas. Information collected from each mill is assumed to be the best available; and whenever possible, the information came from records. In some cases, however, some of the information had to be estimated. Information for individual mills is strictly confidential, and any information that could reveal critical details of an individual operation has been combined with other data to avoid disclosure.

Data for log consumption and product output are actual figures reported by the mills. Subsequent classification of these data, i.e., by species, ownership, origin, degree of manufacturing, etc., are based on percentage distributions provided by the mills and may not agree precisely with other published figures. Statistics on mill residues are based on average factors applied to product output. As such, they may differ from actual volumes for a given mill.

Supporting data are presented in tables 1-78 (Appendix II) at the end of this report. In the tables, "--" indicates the value is either "0" or not available.

Acknowledgments

We appreciate the help of mill owners and operators, who cooperated in order to provide the data for this report, and to the major forest industry associations for their support of this study. Special acknowledgment is made to the following:

- State of Washington, Department of Natural Resources, particularly John A. Bergvall, Forest Analyst, for assistance in processing the data and technical advice on methodology and questionnaires.
- Division of Labor, State of Oregon, for assistance in updating the mill list.

METRIC CONVERSIONS

1 cubic foot = 0.02832 cubic meter

1 ton = 907.1849 kilograms

1 square foot = 0.0929 square meter

Contents

Page

OVERVIEW OF THE INDUSTRY 1

INDUSTRY CHARACTERISTICS 5
  Total number of mills down 5 percent since 1972 5
  Larger sawmills increase in number 5
  Size-class A sawmills have 64 percent of total capacity. . . 5
  Little change in industry-wide capacity 5
  Fewer burners operating in 1976 6
  Twenty chipping saws in use in 1976 6
  The use of chippers continues to increase 6
  Equipment changes in the veneer and plywood industry 7
  Sawmills operate fewer shifts per day 7

WOOD CONSUMPTION 7
  Log consumption down from 1972 7
  Public lands share of log consumption down from 1972 7
  Almost one-third of logs were young growth 8
  Lane County is the leader in log consumption 8
  Three resource areas are net importers of logs 8
  Douglas-fir accounts for 60 percent of log consumption . . . 9
  Twenty-four mills account for 38 percent of sawmill log consumption 9
  Pulp and board industry wood consumption up 8 percent from 1972 10

MILL RESIDUES. 10
  Almost 15.4 million tons of residue produced during 1976 . . 10
  Almost 98 percent of wood residue was used 11
  Veneer and plywood industry had highest rate of wood residue use 11
  Most wood residue goes to pulp and board industries 11
  Almost two-thirds of the veneer cores were sent to sawmills 12
  Largest volumes of unused residues were in the Blue Mountain and southwest areas 12
  Smaller sawmills make significant gain in residue use . . . 12

THE HARDWOOD INDUSTRY 13
  All hardwood sawmills were small 14
  Most hardwood mills are in northwest area. 14
  Hardwood mills get 98 percent of their logs from Oregon. . . 14
  Private lands supplied a majority of logs 14
  Hardwood sawmills produced 42 million board feet of lumber 15
  Over 56,000 tons of residues produced. 15

APPENDIX I 16
  Measurement units 16
  Mill residues. 16
  Definitions 18

APPENDIX II 19

Overview of the Industry

The value of the forest industry to the State and the Nation is widely known. Supported by the greatest timber inventory in the country, Oregon's forest products industry provides over one-fifth of the Nation's wood products. Oregon ranks first in production of lumber, plywood, particleboard, and hardboard and sixth in pulp production. In addition to producing a considerable volume of shakes and shingles and posts, poles and pilings, about one-sixth of the logs exported from the United States pass through Oregon ports. Figure 1 charts the production of some of Oregon's major products over the past 11 years.

Activity of the industry is of great importance to the economy of the State. In 1976 employment in the forest products industry[1/] amounted to just over 86,000 people, 71 percent associated with the primary processing industries covered in this report. This employment level represents about one-half of all manufacturing-based employment in the State. The payroll for the forest products industry was over $1.2 billion, exceeding $1 billion for the 3d year in a row.

Economic impacts such as these indicate the tremendous influence the industry has on the lives of most people. Yet the viability of the industry is even more crucial to many small communities throughout the State. In numerous cases small towns or communities are almost entirely dependent upon the local forest industry for employment.

Decisionmakers and planners need to know about technological advances, existing structure of the industry, how the industry is adapting to a changing timber supply, and how efficiently the timber is used. Trends within the industry are also of importance to many people.

This report provides much of this information. The data presented in this report give an in-depth look at the forest products industry for 1976. In addition coupled with similar reports for 1968 and 1972,[2/] this report also provides the background for analyzing the dynamic effects of supply and demand on the industry.

[1/] Includes all employees within Census of Manufacture classification SIC 24 (Lumber and Wood Products), and SIC 26 (Paper and Allied Products).

[2/] Schuldt, John P., and James O. Howard, "Oregon Forest Industries,1972 Wood Consumption and Mill Characteristics," Oregon State University Special Report No. 427, Dec. 1974, 113 p.

Manock, Eugene R., et al., "Oregon Timber Industries, 1968, Wood Consumption and Mill Characteristics," State of Oregon Department of Forestry, 1968, 122 p.

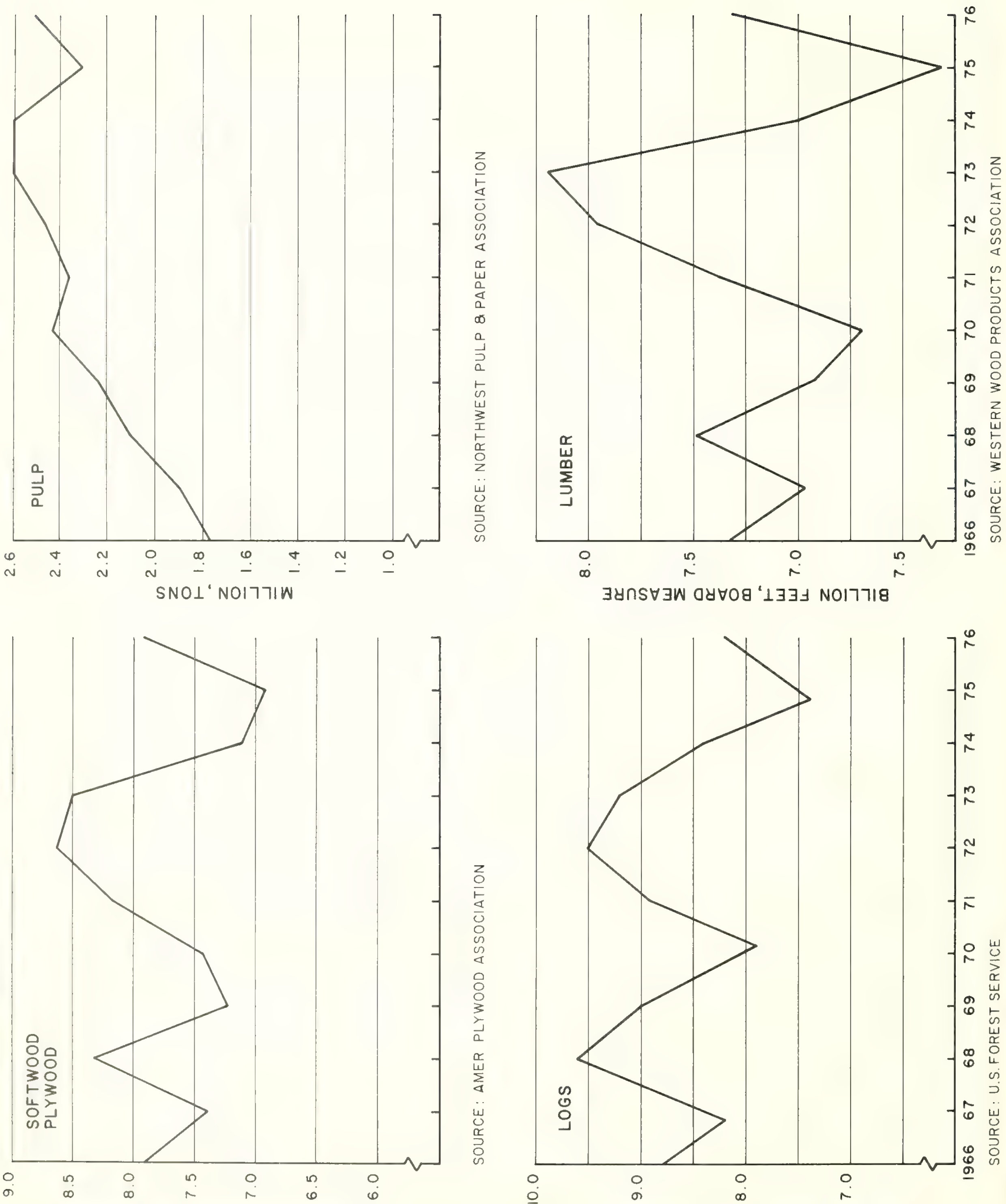


Figure 1.--Output of major timber products in Oregon, 1966-1976.

As used in this study, the forest industry[3] refers to six primary log processing and mill-residue-using industries: sawmills, veneer and plywood, pulp and board, shake and shingle, post, pole, and piling, and export (logs only).

The location of the forest industry in Oregon is closely related to the geographic distribution of the timber resource. As would be expected a large share of the industry is situated in the heavily timbered area west of the Cascade Range. This is shown in figure 2 which indicates that 79 percent of the log consumption occurred in western Oregon.

The State has been divided into five resource areas (fig. 3). Designation of these areas reflects both the nature of the timber and the historic marketing structure of the industry. This is borne out by the study data which show that on the average 88 percent of the logs processed in a particular resource area were harvested within the area boundaries.

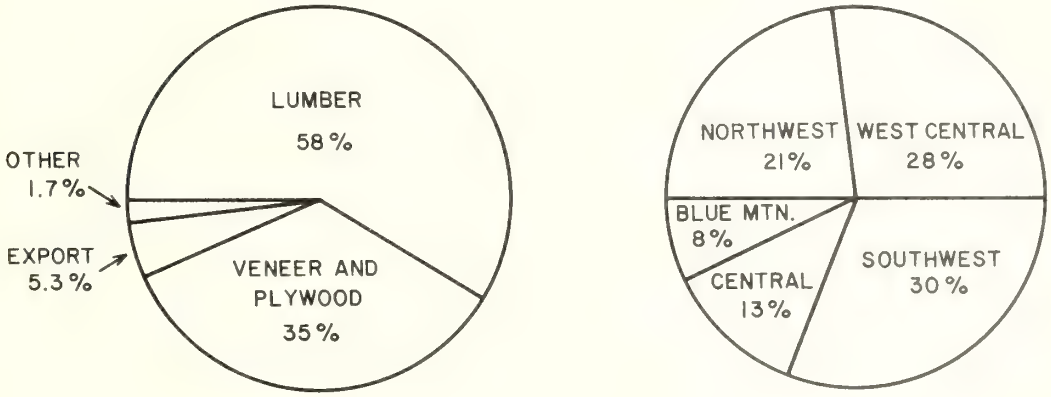


Figure 2.--Distribution of log consumption by resource area and industry, 1976.

---

[3] These industries are also commonly referred to as the "forest products industry" or "timber industries," but may include other operations such as Christmas tree production. The term mill refers to all types of processing plants or separate processes at pulp mills.

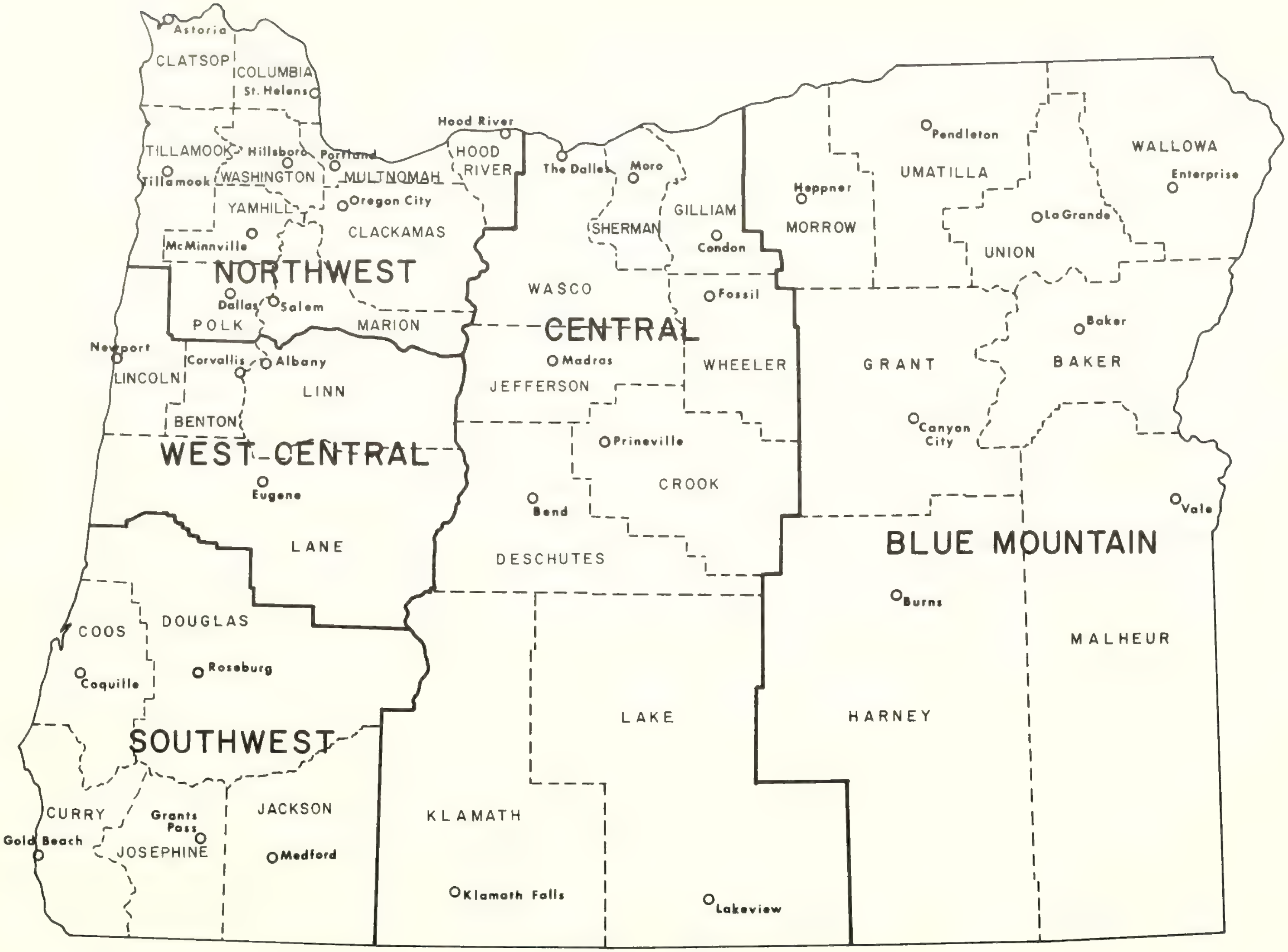


Figure 3.--Resource areas, Oregon forest industry survey, 1976.

Industry Characteristics

TOTAL NUMBER OF MILLS DOWN 5 PERCENT SINCE 1972

In 1976 a total of 498 mills[4] were identified by this survey, down 5 percent from 1972. Most of the decline occurred in the sawmill sector which decreased by 19 mills. Also declining somewhat was the export sector with 37 facilities operating in 1976 compared to 48 in 1972. This change appears to reflect two factors. First, the export companies are concentrating their operations in fewer ports while maintaining their total volume of exported logs. Second, export operations have ceased at Port Westward in Columbia County. In 1972, five companies operated at this port.

While the number of mills in western Oregon has decreased, the industry east of the Cascades has increased in size. From 12 percent of all mills in the State in 1968, the east side industry has risen to 15 percent in 1976. During that period, there was an absolute increase of 10 mills. Most of the gains were in the plywood and pulp and board sectors, which added five and four mills respectively.

LARGER SAWMILLS INCREASE IN NUMBER

Statewide, the number of sawmills dropped from 300 in 1968 to 243 in 1976. On the east side, the number remained constant, while the west side has lost 57 mills. During this same period, the largest sawmills, those with an 8-hour shift capacity of 120+ thousand board feet[5] (size-class A), increased from 59 to 88, a 49 percent gain. Size-class D mills, those with a capacity of less than 40 thousand board feet per 8-hour shift, dropped from 102 to 51 mills.

Of the 51 class D mills in the State, over half, 27, were operating in the northwest area. Eight of these were portable mills. Two factors are apparent contributors to this situation: (1) the relatively large volume of second-growth timber in the area, and (2) the proportion of small nonindustrial timber holdings is much higher than the statewide average.

SIZE-CLASS A SAWMILLS HAVE 64 PERCENT OF TOTAL CAPACITY

The larger sawmills have increased their share of total capacity one-third since 1968. Between 1968 and 1976, size-class A sawmills increased their proportion of total capacity from 48 percent to 64 percent. The proportion in the other three size classes decreased during the same period. Log consumption by size-class A mills increased from 49 percent of the total in 1968 to 70 percent in 1976. Size-class C and D mills' log consumption dropped from 23 percent to 11 percent.

LITTLE CHANGE IN INDUSTRY-WIDE CAPACITY

Over all, there has been little change in industry capacity since 1972. While sawmill capacity is down somewhat from earlier levels, veneer and plywood capacity is up slightly. This latter figure is difficult to assess due to a change in reporting standards for veneer and layup mills.

Of greater interest was a change in average mill capacity. Since 1968, average 8-hour shift capacity of all sawmills has increased from 76 thousand board feet to 104 thousand board feet. Average capacity of veneer and plywood mills went up only slightly. Analysis of the data indicate that the increase in average sawmill capacity is due to a decline in smaller mills rather than increasing mill size. This is shown in the following tabulation.

---

[4] As defined for this study, mills refer to identifiable operations at a particular location, whether it be a sawmill, pulping process, or a log export facility.

[5] Capacity is rated against lumber production rather than log consumption.

Average 8-hour shift capacity for sawmills, by size class and average for all mills

	Sawmill size class				
	A	B	C	D	
	(120+ Mbm)	(80-119 Mbm)	(40-79 Mbm)	(<40 Mbm)	(Average)
	- - - - - Thousand feet, board measure - - - - -				
1968	185	94	58	15	76
1972	179	96	58	16	97
1976	185	94	60	16	104

FEWER BURNERS OPERATING IN 1976

Tighter environmental regulations and increased value for mill residues led to an 80-percent decline in the use of burners by the residue-producing industries.[6/] In 1968, there were 291 waste burners operating in the State. In that year, 60 percent of the mills operated a burner. By 1972, only 26 percent of the mills relied on burners to dispose of waste wood and bark. In 1976, there were only 58 burners in use in the State, representing 14 percent of the residue-producing mills.

TWENTY CHIPPING SAWS IN USE IN 1976

A relatively new type of headrig used by the sawmill industry is the chipping saw. This saw is designed to process small logs more efficiently than conventional equipment, while producing high quality chips in the process. This type of saw literally chips the log into a squared or profiled cant, which is then resawn into dimension material, frequently 2x4's. Data for previous surveys is not available; however, in 1976 there were 20 of these saws in operation. Seven of the chipping saws were in the Northwest area. About 6 percent of all lumber production was produced with these saws.

As in the past, band saws continue to be the mainstay of the industry producing 79 percent of the lumber in 1976.

THE USE OF CHIPPERS CONTINUES TO INCREASE

Another piece of equipment used to enhance efficient use of logs is the chipper. This equipment handles both residual portions of sawn logs and entire logs of poorer quality or size which would produce little or no lumber. Chipped material from this equipment has a myriad of uses but is primarily used as plant fuel or sold to pulpmills. Chippers have been prominent in the industry for years but continue to increase in use. In 1968, about 68 percent of the sawmills had chippers, by 1976 this proportion had increased to 85 percent. All but two of the size-class A mills operated chippers, while just less than one-half of size-class D mills used them. Not indicated by this survey is the change in size and efficiency of chippers over the survey period.

[6/] The residue-producing industry is comprised of sawmills, veneer and plywood mills, and shake and shingle mills.

EQUIPMENT CHANGES IN THE VENEER AND PLYWOOD INDUSTRY

The veneer and plywood industry, while being relatively stable in terms of numbers of mills, has undergone some significant changes in equipment. From 1968 to 1976, the number of cold presses used decreased from 19 to 5, down 74 percent, while the use of hot presses increased from 41 to 79 percent. During this period, the use of core chippers has increased 29 percent. Like the sawmill sector, the number of waste burners has declined significantly going from 66 in 1968 to only 15 in 1976.

SAWMILLS OPERATE FEWER SHIFTS PER DAY

During 1976, sawmills averaged 1.38 shifts per day, while veneer and plywood mills operated 2.24 shifts per day.

Size class A sawmills had the highest average among all sawmills, averaging 1.59 shifts per day, while class D mills averaged only 1.02 shifts per day. In the southwest and Blue Mountain areas, veneer and plywood mills averaged about 2.5 shifts per day; in the other three areas the average was 2.1 shifts per day.

In 1976, sawmills operated an average of 219 days per year, while veneer and plywood mills averaged 245 days per year. As expected, larger mills operated more days than did the smaller mills.

Wood Consumption

LOG CONSUMPTION DOWN FROM 1972

Total log consumption[7] for the forest industry in 1976 was 9,339 million board feet, Scribner scale. This represents a 10.5-percent decrease from that reported in 1972 and 7.6-percent less than in 1968.[8] As shown in figure 2 sawmills accounted for 58 percent of total log consumption, and veneer and plywood mills consumed 35 percent. Only the export sector showed an absolute increase in log consumption from 1972 to 1976, up 12.8 million board feet, or about 3 percent.

PUBLIC LANDS SHARE OF LOG CONSUMPTION DOWN FROM 1972

As indicated in the following tabulation, log consumption by ownership class had not changed much since 1968. The total public lands share at 56 percent for 1976 is down 5 percent from 1972, but about the same as the 1968 level.

---

[7] Here and elsewhere in this report, log consumption is reported in Scribner log scale.

[8] The tables in the 1968 report show a total volume of 9,594,675 thousand board feet; however, export and post, pole, and piling volumes were given elsewhere in that report, bringing the total to 10,102,575 thousand board feet.

Log consumption by ownership class, all industries for selected years

	Public				
	National Forest	BLM	Other public	Forest industry	Farmer and miscellaneous private
	Percent				
1968	40	15	2	35	8
1972	40	15	6	34	5
1976	37	13	6	36	8

In absolute terms, public lands accounted for 5,240 million board feet in 1976 with private lands contributing 4,099 million board feet.

ALMOST ONE-THIRD OF LOGS WERE YOUNG GROWTH

In 1976, more than 2.9 billion board feet of young-growth logs (less than 100 years old) were consumed by the forest industry. This represents over 31 percent of total log consumption, up only slightly since 1972, but continuing the upswing since 1968. As in the past, the northwest area industry had the highest proportion, 60 percent, of its logs coming from young-growth timber. Mills on the east side of the State showed a relative decline in consumption of young-growth logs from 24 percent of total consumption in 1972 to 17 percent in 1976. The "other industries" sector reflected the greatest change since 1972. Consumption of young-growth logs increased from 29 percent of total consumption to 50 percent between 1972 and 1976.

LANE COUNTY IS THE LEADER IN LOG CONSUMPTION

The forest industry in Lane County continues to be the largest in the State. Log consumption by all mills in the county was 1,776 million board feet in 1976. This amounted to 19 percent of the State's total, up from 18 percent in 1972. Following Lane County in log consumption were Douglas County with 1,124 million board feet and Coos County with 798 million board feet. On the east side, Klamath County was by far the largest user of logs with 570 million board feet, ranking fourth in the State.

THREE RESOURCE AREAS ARE NET IMPORTERS OF LOGS

Analysis of table 4 indicates that the northwest, west central, and Blue Mountain areas had a net inflow of logs in 1976. The northwest area had the largest net inflow, 405 million board feet. Most of this, 278 million board feet, came from out of State to the export sector. The west central area had a net inflow of 93 million board feet, while the Blue Mountain industry consumed only 4 million board feet, more than originated within the area. The southwest and central Oregon areas had net outflows of 56 million board feet and 30 million board feet, respectively.

The log flow pattern for the State as a whole is illustrated by figure 4.

Overall, 88 percent of the logs consumed within a resource area were harvested in the same area. Only 88 million board feet of logs were reported moving from the east to the west side.

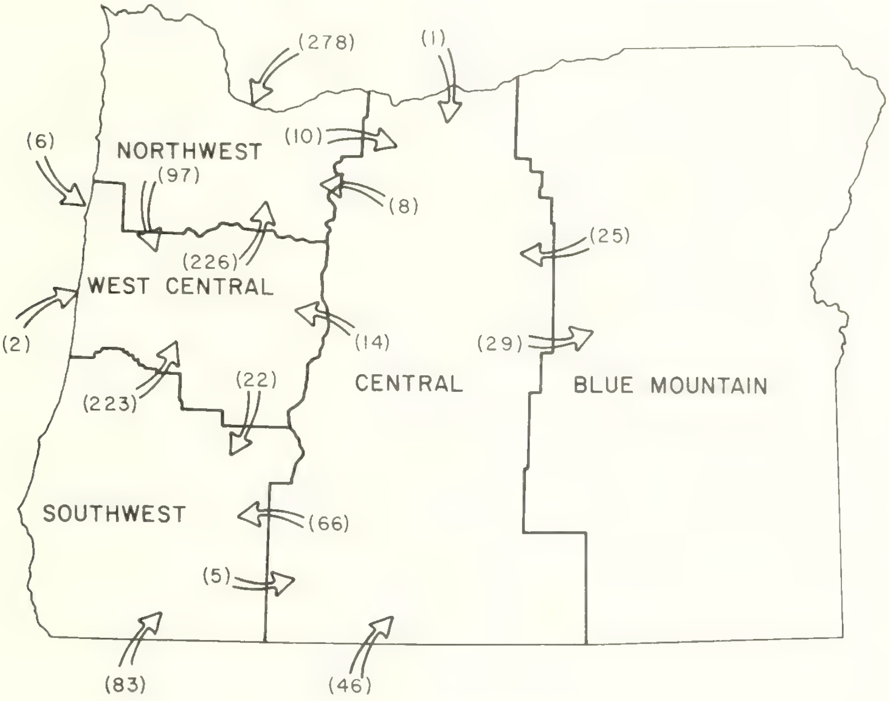


Figure 4.--Flow of logs between resource areas and from out-of-State origins.

DOUGLAS-FIR ACCOUNTS FOR 60 PERCENT OF LOG CONSUMPTION

Douglas-fir continues to be the predominant species in terms of log consumption. In 1976, a total of 5,632 million board feet of Douglas-fir logs were used by the forest industry, amounting to just over 60 percent of the total. This proportion is slightly lower than in 1972 and down 5 percent from the 1968 level. Increasing in proportion to total consumption were the true firs, ponderosa pine, and lodgepole pine. Lodgepole pine was the only species to show an increase in absolute consumption since 1972.

TWENTY-FOUR MILLS ACCOUNT FOR 38 PERCENT OF SAWMILL LOG CONSUMPTION

As shown in the following tabluation, the largest sawmills have increased their share of total log consumption since 1968.

Number and log consumption of Oregon sawmills[1]
by annual consumption class for selected years

Annual consumption class (million board feet)	1968		1972		1976	
	Number of mills	Log consumption	Number of mills	Log consumption	Number of mills	Log consumption
		Million board feet		Million board feet		Million board feet
50.9+	21	1,724	27	2,280	24	2,066
25.0-49.9	72	2,616	68	2,437	61	2,080
5.0-24.9	106	1,391	95	1,316	96	1,170
0.001-4.9	90	132	65	108	53	88
All classes	289	5,863	255	6,141	234	5,404

---

[1] Does not include mills that cut only peeler cores.

In 1976, the 24 largest mills in the State, consuming more than 50 million board feet per year, accounted for 38 percent of total log consumption by the sawmill sector. This is up from 29 percent in 1968 but only slightly higher than in 1972. This was the only size-class of the four to experience a relative gain in proportion over the period of 1968 to 1976. In 1976, there were 85 mills that used 25 million board feet or more of logs. These mills consumed almost 77 percent of the total log consumption by sawmills, while accounting for only 36 percent of the total number of mills.

PULP AND BOARD INDUSTRY WOOD CONSUMPTION UP 8 PERCENT FROM 1972

In 1976, the pulp and board industry consumed 7,296,498 tons of mill residues and off-site roundwood chips, and 71 million board feet of logs. The total wood consumption for 1976 represents an increase of 8 percent over 1972 and is 46 percent higher than in 1968. The most radical change in the raw material supply has been the use of off-site roundwood chips. From 1968 to 1972, the industry moved from consumption of 2,900 tons of off-site chips to 71,000 tons. By 1976, this figure had risen to almost 672,000 tons, an increase of 840 percent since 1972. In part this may be due to a general tightening of the availability of mill residues. This can be seen from the data which show an increase of only 26,724 tons of mill residues from 1972 to 1976, while off-site chips increased 600,299 tons. Both logs and bark showed a decrease in consumption over the same period.

During 1976, pulp mills also reported use of 111,435 tons of wastepaper. Also used by the industry were thousands of tons of wood and bark in the form of hog fuel burned for energy production.

Mill Residues

ALMOST 15.4 MILLION TONS OF RESIDUE PRODUCED DURING 1976

The residue-producing industries (sawmills, veneer and plywood, shake and shingle) generated 15.4 million tons (dry weight) of residue material during 1976. Wood residues accounted for 12.2 million tons, or 79 percent of the total. Sawmills generated 56 percent of all residue, veneer and plywood mills 43 percent, and shake and shingle mills less than 1 percent. With the greatest concentrations of residue-producing industries, the west central and southwest areas produced a total of 62 percent of the State's total.

ALMOST 98 PERCENT OF WOOD RESIDUE WAS USED

Almost 98 percent of the wood residue generated during 1976 was put to a useful purpose. The remaining 2 percent was either burned or otherwise disposed of. The level of utilization attained in 1976 was 13 percent higher than that in 1968, and 3 percent higher than the 1972 level.

The use of bark has increased dramatically over the survey period. In 1976, about 92 percent of the bark was used, compared to only 57 percent in 1968. In relative terms, 60 percent more bark was used in 1976 than in 1968.

VENEER AND PLYWOOD INDUSTRY HAD HIGHEST RATE OF WOOD RESIDUE USE

The veneer and plywood industry was the leader in disposition of wood residues, finding uses for 99 percent. Sawmills followed closely behind with 97 percent, while shake and shingle mills found uses for only 60 percent. The lower rate of utilization by the shake and shingle industry is primarily attributable to two factors. First, residues are generated in rather small quantities, thus being more difficult to market. Second, western redcedar, the species used almost exclusively, is not heavily demanded by the pulp and board industries.

MOST WOOD RESIDUE GOES TO PULP AND BOARD INDUSTRIES

As seen in the following tabulation, a majority of the wood residue in 1976 was distributed to the pulp and board industries, including export to foreign markets. For bark, however, over three-fourths was used for fuel, either by the producing mill or sold to others.

Disposition of residues for 1968, 1972, and 1976

	Wood			Bark			Wood and bark		
Disposition	1968	1972	1976	1968	1972	1976	1968	1972	1976
Pulp and board	61.6	69.5	73.1	--	1.1	0.6	48.7	55.3	57.9
Fuel	20.0	19.5	15.6	49.8	61.5	75.7	26.3	28.2	28.2
Miscellaneous	5.3	6.1	9.2	7.4	14.9	15.2	5.7	7.9	10.5
Unused	13.1	4.9	2.1	42.8	22.5	8.5	19.3	8.6	3.4

While pointing out general trends in residue use, analysis of the data also points out an interesting situation.

Since the 1972 survey, there has been increased emphasis on alternative fuel sources brought about by restricted supplies and higher prices for petroleum products. Thus it would be expected that residues channeled to fuel would have increased over the past 4 years. As the data above indicates, there was no overall increase in the proportion of residue used for fuel between 1972 and 1976. It is generally accepted, however, that the forest products industry is the largest consumer of mill residues for fuel. Thus, when less product is manufactured and fewer days worked, the industry requires less fuel for its energy needs.

If the forest products industry is the major user, then the proportion of residue used for fuel would remain nearly the same, assuming no major technological changes. Conversely, if other industries used a major share of the residue for fuel, a change in production levels by the forest industry would have less effect on the total volume demanded by all users. To test this assumption, a ratio of residue used for fuel to log consumption has been developed for 1972 and 1976. Product output may have been a better standard to use, but the widely different measurement standard for the various sectors made comparability almost impossible. Analysis of the data indicate that little change occurred in the above ratio between 1972 and 1976. In 1976 the ratio of residue used for fuel to log consumption was 929 pounds per thousand board feet. This is almost the same as for 1972 when the ratio was 927 pounds per thousand board feet. Thus, it appears that the relative stability in the use of residues for fuel between 1972 and 1976 is tied to the level of output of forest industry.

While these data do not indicate a major step toward greater self-sufficiency in terms of energy usage, the literature suggests a definite upward trend into the future. A major issue facing many mills is the conflict between the value of residues when sold for other products and the increasing probability of facing an interruptible supply of conventional energy.

ALMOST TWO-THIRDS OF THE VENEER CORES WERE SENT TO SAWMILLS

Over 99 percent of the cores generated in the production of veneer were used in 1976. Almost two-thirds, 65 percent, were sent to the sawmill sector for subsequent manufacture into sawn products, frequently 2x4's. Most of the remaining volume was chipped for use by the pulp and board industry. In light of increased installation of core chippers, the future may see an upswing in chip production from cores.

LARGEST VOLUMES OF UNUSED RESIDUES WERE IN THE BLUE MOUNTAIN AND SOUTHWEST AREAS

Nearly one-third of the volume of unused wood residues were located in the Blue Mountain area. The market for this material is affected by a relatively small pulp and board industry, and geographic isolation from residue-using industries in other areas of the State. Even with this handicap, the residue producing industry managed to find use for over 91 percent of the wood residues produced.

About one-half of all unused bark was found in the southwest area. The lowest degree of utilization of bark was in the Blue Mountain area, where only 81 percent was used. The southwest area had the second lowest usage at 87 percent. For the State as a whole, over 91 percent was used.

As would be expected, the resource area with the largest pulp and board industry had the highest level of residue utilization. Sawmills in the west central area reported 100-percent utilization of both wood and bark residues. Veneer and plywood mills found use for over 99 percent of residual materials. Over all, less than one-half of 1 percent of the residue generated in the area was not used.

SMALLER SAWMILLS MAKE SIGNIFICANT GAIN IN RESIDUE USE

As the data below show, large sawmills utilized a greater proportion of their residue than did the smaller mills. The advantage of the larger mills lies in the larger volumes of residues generated and the greater degree of diversification associated with the ownership of these mills.

Percent of wood and bark residue utilized by sawmill size-class

Sawmill Size-class	Wood Residue 1968	Wood Residue 1972	Wood Residue 1976	Bark Residue 1968	Bark Residue 1972	Bark Residue 1976
A	94.8	95.4	98.3	72.8	79.8	93.4
B	81.5	90.5	95.6	35.2	60.9	88.9
C	74.7	92.6	95.1	45.9	73.5	87.9
D	51.6	82.6	90.9	29.8	64.8	85.8
All mills	84.5	94.0	97.5	54.1	75.3	92.0

The smaller sawmills have made significant gains in utilization of residues since 1968. Much of this is due to increased demand for mill residue coupled with an already high degree of utilization by the larger mills.

It is apparent from these figures that future changes in the residue use picture will be associated with trade-offs among competing alternative uses rather than increases in overall utilization.

Veneer and plywood mills are not categorized by size class, thus making this type of comparison impossible. The fact that 99 percent of wood residues and 91 percent of bark are used, however, indicates that most mills are successful in finding useful disposition of their manufacturing by-products.

The Hardwood Industry

Hardwoods constitute about 8 percent of the sawtimber inventory in western Oregon. Yet hardwoods account for less than 1 percent of the State's log consumption. In 1976, reported consumption of hardwood logs was 65.5 million board feet, 0.7 percent of total consumption, nearly 100 percent of this occurring west of the Cascades.

Although the volume of hardwood log consumption is relatively small, a number of secondary manufacturers rely heavily on hardwood lumber for products such as cabinets, millwork, and furniture stock. What the future holds for the current hardwood resource is very uncertain. Many stands of hardwood are being converted to conifers. Declining supplies of softwood timber, however, may require a new look at the little used hardwoods. Understanding the existing hardwood industry is an important element in the analysis of the supply and demand for hardwood timber.

In this report, hardwood industry refers to mills[9/] that use hardwood logs almost exclusively. A few mills process small volumes of hardwood logs, but study results show no mills using between 5 and 90 percent hardwood logs. Thus, the hardwood industry includes only those mills using 90+ percent of hardwood logs.

Following the definition above, there were 19 hardwood mills in western Oregon consisting of 18 sawmills and 1 veneer mill. Reported hardwood log consumption of these mills was 45.5 million board feet.

[9/] These hardwood mills are included in all data and discussion of the sawmill industry as previously identified.

In addition, the pulp and board industry used 16.45 million board feet of hardwood logs, most of this in the southwest area.

ALL HARDWOOD SAWMILLS WERE SMALL

Of the 18 sawmills, only one mill had a capacity exceeding 30 thousand feet, board measure per shift. Total capacity for the sawmills was 301 thousand feet, board measure per 8-hour shift. The sawmills averaged one shift per day and operated an average of 202 days during 1976. The veneer mill operated one shift per day for 180 days.

Most of the mills have been in operation for many years. As of 1976, almost 80 percent had been operating for 10 years or more and five mills exceeded 20 years of operation. There was only one mill that had come on line since 1972.

MOST HARDWOOD MILLS ARE IN NORTHWEST AREA

Geographically, the hardwood mills are scattered throughout western Oregon. Listed below are the counties where the mills were located. As can be seen the northwest area led with 10 mills.

Number of hardwood mills by resource area and county

Northwest	West central	Southwest
Clatsop (1)	Benton (2)	Coos (2)
Columbia (1)	Lane (2)	Douglas (1)
Marion (2)	Lincoln (1)	
Polk (3)[10]	Linn (1)	
Tillamook (3)		

The counties with the greatest log consumption, Tillamook, Coos, and Benton, accounted for 27.5 million board feet, 60 percent of the total.

HARDWOOD MILLS GET 98 PERCENT OF THEIR LOGS FROM OREGON

The industry reported only 905 thousand board feet of logs imported into the State from Washington. The remainder, 98 percent, originated from lands within the State. Approximately 70 percent of the logs consumed in a county originated in the same county. This proportion is slightly higher than for the statewide industry. In terms of origin of logs, Tillamook, Lincoln, and Benton Counties were the largest suppliers, with 9.6, 8.0, and 6.1 million board feet, respectively, 53 percent of the total.

PRIVATE LANDS SUPPLIED A MAJORITY OF LOGS

Logs from private lands accounted for 63 percent of the consumption in 1976. The next largest sources were National Forest and State lands at 15 and 14 percent.

This distribution is quite different from the forest industry as a whole. Overall, 44 percent of the logs come from private lands.

---

[10] Includes one veneer mill.

The explanation for this difference lies in the natural distribution of hardwood stands. Most of the better hardwood stands, particularly red alder, occur in the lower elevations of the Coast and Cascade Ranges and in river bottoms throughout western Oregon. A majority of these lands are privately held and very accessible, thus leading to the log distribution noted above.

HARDWOOD SAWMILLS PRODUCED 42 MILLION BOARD FEET OF LUMBER

In 1976, the hardwood sawmills produced a total of 42 million board feet of sawed products. The dimensions of these products are somewhat different than for softwood lumber due to the specialized needs of the secondary manufacturers, such as cabinet makers and furniture manufacturers. Of the total production, 64 percent was sold rough green and 59 percent was surfaced dry.

OVER 56,000 TONS OF RESIDUES PRODUCED

In the manufacturing process, the hardwood industry generated 42,231 tons of wood residue and 13,796 tons of bark. Over 98 percent of these residues were utilized, slightly higher than the average for all forest product industries. Shown below are the percent disposition of the residue generated.

Residue Disposition of Hardwood Mills

Disposition	Wood	Bark
	- - - - - Percent	- - - -
Pulp and board	59	35
Fuel		
Used by mill	18	24
Sold	14	18
Miscellaneous	8	18
Unused	1	5

Appendix I

MEASUREMENT UNITS

Board foot is the unit of measure used in this report for all wood consumption with the exception of purchased or transferred veneer consumed by plywood mills (square feet, 3/8-inch basis) and mill residues consumed by pulp and board mills (tons, dry weight). Consumption by mills not reported in these units was converted using the following general factors:

1 cord = 500 board feet
1 ton = 500 board feet
10.5 squares = 1,000 board foot
1 lineal foot = 3.8 board feet
1 cubic foot = 6 board feet
200 cubic foot unit = 1 bone-dry ton
1 bone-dry unit = 1.2 bone-dry tons

Board-foot lumber talley is the unit of measure used for lumber production, and square feet 3/8-inch basis for veneer and plywood production; square (100 square feet) for shake and shingle production.

MILL RESIDUES

In this study no attempt was made to get individual mills to quantify the amount of residue produced. Although many mills might be able to specify amounts of residue sold for high value uses, such as pulp chips, the lower value uses such as mulch or fuel are difficult to quantify. Therefore, the mills were only asked to indicate the percentage distribution of the disposal of their residues. These percentages were then applied to residue estimates derived through use of the following factors:

Softwood Sawmill Residue[1]

Average quantity of residues developed from producing one thousand board feet of lumber

Type of output	Solid volume[2]		Dry weight	
	Cubic feet	Percent[3]	Western Oregon	Eastern Oregon
			- - - Tons - - -	
Wood residues:				
Slabs, edgings, sawmill trim	36	24.5	0.486	0.480
Planer trim	3	2.0	.041	.036
Sawdust	16	10.9	.216	.264
Planer shavings	16	10.9	.216	.192
Total wood residue	71	48.3	.959	.972
Bark	19	12.9	.258	.228
Lumber	57	38.8	.864	.780
Whole log	147	100.0	2.081	1.980

---

[1] Based on data from Oregon mills compiled by Oregon State University, School of Forestry, in 1967, and adjusted for changes in lumber standards in 1974 by James O. Howard, Resource Analyst, Pacific Northwest Forest and Range Experiment Station.

[2] Equivalent undried solid volume of residue.

[3] Percent of log by volume.

Softwood Plywood Residue[4]

Average quantity of residue developed in producing the equivalent of 1,000 square feet of 3/8-inch plywood

Type of output	Solid volume[5]	Dry weight	Proportion of dry weight
	Cubic feet	Tons	Percent of whole log
Wood residues:			
Log trim	3.4	0.048	4.4
Spur trim, roundup, and veneer clip	19.3	.270	24.3
Core	6.3	.088	7.9
Dry trim and layup loss	6.3	.088	7.9
Sander dust	1.6	.021	1.9
Total wood residue	36.9	.515	46.4
Bark	8.8	.132	11.9
All residues	45.7	.647	58.3
Plywood	34.9	.463	41.7
Whole log	80.6	1.110	100.0

Hardwood Sawmill Residue[6]

Average residue developed from producing 1,000 board feet of lumber using a narrow kerf bandsaw

Type of residue	Dry tons
Coarse	0.60
Shavings	.22
Bark	.34
Sawdust	.23

---

[4] All residue factors, except sander dust and bark, from data collected in various mill studies by the Characterization and Utilization of Western Softwoods and Forest Residues Project, Pacific Northwest Forest and Range Experiment Station, and compiled by James O. Howard, Resource Analyst. Sander dust and bark factors based on data from Oregon mills compiled in 1967 by Oregon State University, School of Forestry.

[5] Volumes are based on equivalent green volume.

[6] Based on information furnished by Northwest Hardwoods, Inc.

Shingle Mill Residue[7]

Average quantity of residue developed in utilizing 1,000 board feet of logs, Scribner scale, or in producing the equivalent volume of 10.5 squares

Type of residue	Solid volume	Percent	Dry weight per thousand board feet
	Cubic feet		Tons
From shingles:			
Coarse	23	13.7	0.22
Fine	78	46.8	.75
Bark	19	11.5	.28
From shakes:			
Coarse	23	13.7	.22
Fine	24	14.5	.23
Bark	19	11.5	.28
From hip and ridge, and other:			
Coarse	23	13.7	.22
Fine	51	30.6	.49
Bark	19	11.5	.28

DEFINITIONS

Old-growth timber:	Timber at least 100 years old.
Sound log:	Number 3 sawlogs and better in grade and having the following minimum specifications: 6-inch diameter, 12-foot length, 50-board foot net scale.
Utility log:	Logs having the following minimum specifications; 6-inch diameter, 12-foot length, 50+ percent of gross scale chippable.
Young-growth timber:	Timber less than 100 years old.
Mill:	An identifiable operation at one location. For example, a sawmill with a large log and a small log operation would be counted as two mills; also a sulfate and a groundwood pulping process at one location would be counted as two mills.
Off-site roundwood chips:	Chips from logs that are processed at a chipping mill, not as part of a milling operation, then transported to the user.
Apparent log receipts:	The sum of a mill's log consumption and gain or loss in inventory.

---

[7] Based on discussions with the Redcedar Shingle Bureau.

Appendix II

Table 1--*Number of mills by type of industry and resource area, Oregon, 1976*

Resource area	All industries	Industry					
					Other		
		Lumber	Veneer and plywood	Pulp and board[1]	Shake and shingle	Export[2]	Post, pole, and piling
Northwest	138	70	21	12	15	16	4
West Central	167	67	53	14	26	3	4
Southwest	118	54	44	7	4	9	--
Central	43	29	9	4	--	--	1
Blue Mountain	32	23	5	3	1	--	--
All Areas	498	243	132	40	46	28	9

[1] Each pulping process at a multiplant location is considered an individual mill.

[2] Represents the number of identifiable operations involved in the export trade.

Table 2--*Wood consumption be mills by type of material, resource area, and industry, Oregon, 1976*

Resource area and industry	Roundwood			Other[1]	Residue[2]
	All roundwood	Sound logs	Utility logs		
	- - - - - Thousand board feet, Scribner log rule			- - - - -	Tons, dry weight
Northwest					
Lumber	1,150,666	1,070,811	79,855	76,498	--
Veneer and plywood	404,617	367,726	36,891	--	--
Pulp and board	56,000	15,000	41,000	--	1,801,241
Shake and shingle	6,553	4,228	2,325	6,370	--
Export	338,690	338,690	--	--	--
Post, pole, and piling	19,345	18,607	738	--	--
Total	1,975,871	1,815,062	160,809	82,868	1,801,241
West Central					
Lumber	1,420,698	1,253,582	167,116	112,693	--
Veneer and plywood	1,177,643	893,699	283,944	--	--
Pulp and board	--	--	--	--	3,085,234
Shake and shingle	26,814	21,517	5,297	2,996	--
Export	20,920	20,920	--	--	--
Post, pole, and piling[3]	6,328	6,328	--	--	--
Total	2,652,403	2,196,046	456,357	115,689	3,085,234
Southwest					
Lumber	1,278,974	1,135,970	143,004	110,603	--
Veneer and plywood	1,349,277	1,105,541	243,736	--	--
Pulp and board	15,000	15,000	--	--	1,725,994
Shake and shingle[4]	3,949	2,489	1,460	610	--
Export	134,944	134,694	250	--	--
Total	2,782,144	2,393,694	388,450	111,213	1,725,994
Central					
Lumber	986,698	964,958	21,740	10,674	--
Veneer and plywood	187,725	180,098	7,627	--	--
Pulp and board[5]	--	--	--	--	684,029
Post, pole, and piling[3]	--	--	--	--	--
Total	1,174,423	1,145,056	29,367	10,674	684,029
Blue Mountain					
Lumber	567,320	539,588	27,732	7,617	--
Veneer and plywood	186,443	186,243	200	--	--
Pulp and board[5]	--	--	--	--	--
Shake and shingle[4]	--	--	--	--	--
Total	753,763	725,831	27,932	7,617	--
All Areas					
Lumber	5,404,356	4,964,909	439,447	318,085	--
Veneer and plywood	3,305,705	2,733,307	572,398	--	--
Pulp and board	71,000	30,000	41,000	--	7,296,498
Shake and shingle	37,316	28,234	9,082	9,976	--
Export	494,554	494,304	250	--	--
Post, pole, and piling	25,673	24,935	738	--	--
Total	9,338,604	8,275,689	1,062,915	328,061	7,296,498

[1] Includes peeler cores, cants used by sawmills, blocks, boards, bolts used by shake and shingle mills, and miscellaneous peeled products used by post, pole, and piling mills.

[2] Includes residues from the sawmill, veneer and plywood, and shake and shingle industries, plus chips from roundwood chipping plants.

[3] West Central and Central combined to avoid disclosure.

[4] Southwest and Blue Mountain combined to avoid disclosure.

[5] Central and Blue Mountain combined to avoid disclosure.

Table 3--*Log flows to mills by State of origin, resource area, and industry, Oregon, 1976*

(Thousand board feet, Scribner log rule)

Resource area and industry	Origin					
	All	Oregon	Washington	California	Idaho	Other
Northwest						
Lumber	1,150,666	1,039,197	110,637	--	832	--
Veneer and plywood	404,617	361,448	43,099	--	35	35
Pulp and board	56,000	41,360	14,000	--	--	640
Shake and shingle	6,553	6,313	240	--	--	--
Export	338,690	234,849	103,841	--	--	--
Post, pole, and piling	19,345	14,780	4,565	--	--	--
Total	1,975,871	1,697,947	276,382	--	867	675
West Central						
Lumber	1,420,698	1,418,633	2,065	--	--	--
Veneer and plywood	1,177,643	1,173,643	1,600	2,400	--	--
Shake and shingle	26,814	24,932	1,882	--	--	--
Export	20,920	20,920	--	--	--	--
Post, pole, and piling	6,328	5,762	566	--	--	--
Total	2,652,403	2,643,890	6,113	2,400	--	--
Southwest						
Lumber	1,278,974	1,248,007	--	30,967	--	--
Veneer and plywood	1,349,277	1,299,962	--	49,315	--	--
Pulp and board	15,000	15,000	--	--	--	--
Shake and shingle	3,949	3,949	--	--	--	--
Export	134,944	132,411	--	2,533	--	--
Total	2,782,144	2,699,329	--	82,815	--	--
Central						
Lumber	986,698	964,599	1,050	21,049	--	--
Veneer and plywood	187,725	163,101	--	24,624	--	--
Post, pole, and piling[1]	--	--	--	--	--	--
Total	1,174,423	1,127,700	1,050	45,673	--	--
Blue Mountain						
Lumber	567,320	567,320	--	--	--	--
Veneer and plywood	186,443	186,443	--	--	--	--
Shake and shingle[2]	--	--	--	--	--	--
Total	753,763	753,763	--	--	--	--
All Areas						
Lumber	5,404,356	5,237,756	113,752	52,016	832	--
Veneer and plywood	3,305,705	3,184,597	44,699	76,339	35	35
Pulp and board	71,000	56,360	14,000	--	--	640
Shake and shingle	37,316	35,194	2,122	--	--	--
Export	494,554	388,180	103,841	2,533	--	--
Post, pole, and piling	25,673	20,542	5,131	--	--	--
Total	9,338,604	8,922,629	283,545	130,888	867	675

[1] Combined with West Central to avoid disclosure.

[2] Combined with Southwest to avoid disclosure.

Table 4--Log flows by county and out-of-State origins,

(Thousand board feet,

Resource area and county of use	Totals	Northwest						
		Clackamas	Clatsop	Columbia	Hood River	Marion	Multnomah	Polk
Northwest								
Clackamas	343,868	256,122	11,280	15,234	1,250	9,386	15,966	3,200
Clatsop and Columbia[1]	628,434	35,345	221,313	105,251	--	--	4,787	--
Hood River	92,253	2,295	--	--	45,760	--	--	--
Marion	118,563	3,234	--	--	--	64,522	--	24
Multnomah	216,210	75,085	5,747	34,179	2,338	8,624	19,718	--
Polk	250,217	24,151	--	--	--	10,448	--	57,461
Tillamook	126,357	--	6,642	1,439	--	--	--	--
Washington	63,450	400	6,581	8,943	--	--	--	--
Yamhill	136,519	--	--	--	--	--	--	22,489
Total	1,975,871	396,632	251,563	165,046	49,348	92,980	40,471	83,174
West Central[2]								
Benton	162,308	--	--	530	--	--	--	845
Lane	1,775,577	339	--	--	--	1,395	--	--
Lincoln	154,148	--	--	--	--	--	--	5,544
Linn	560,370	9,048	--	--	--	76,647	--	1,143
Total	2,652,403	9,387	--	530	--	78,042	--	7,532
Southwest[3]								
Coos	797,787	--	--	--	--	--	--	--
Curry	156,901	--	--	--	--	--	--	--
Douglas	1,123,659	--	--	--	--	--	--	--
Jackson	556,971	--	--	--	--	--	--	--
Josephine	146,826	--	--	--	--	--	--	--
Total	2,782,144	--	--	--	--	--	--	--
Central								
Crook	118,726	365	--	--	--	--	--	--
Deschutes and Lake[1]	273,528	--	--	--	--	--	--	--
Jefferson, Wasco, and Wheeler[1]	212,522	8,360	35	106	1,100	--	--	--
Klamath	569,647	--	--	--	--	--	--	--
Total	1,174,423	8,725	35	106	1,100	--	--	--
Blue Mountain								
Baker and Wallowa[1]	139,493	--	--	--	--	--	--	--
Grant and Harney[1]	273,652	--	--	--	--	--	--	--
Umatilla and Morrow[1]	161,534	--	--	--	--	--	--	--
Union	179,084	--	--	--	--	--	--	--
Total	753,763	--	--	--	--	--	--	--
All Areas	9,338,604	414,744	251,598	165,682	50,448	171,022	40,471	90,706

See footnotes at end of table.

resource area, and county of use, Oregon, 1976

Scribner log rule)

			West Central					
Tillamook	Washington	Yamhill	Benton	Lane	Lincoln	Linn	Coos	Curry
3,233	--	1,309	3,570	3,400	--	6,480	--	--
73,076	10,964	--	--	--	540	3,900	--	--
--	--	--	--	--	--	--	--	--
--	--	48	24	2,260	2,100	46,351	--	--
1,788	5,404	3,251	120	--	360	4,956	--	--
9,770	--	37,288	3,750	--	71,943	35,406	--	--
95,525	4,318	1,569	--	--	16,864	--	--	--
11,292	30,483	4,992	--	--	515	--	--	--
56,821	900	32,413	--	--	23.896	--	--	--
251,505	52,069	80,870	7,464	5,660	116,218	97,093	--	--
--	--	--	87,180	23,205	46,493	2,655	--	--
--	--	--	11,285	1,419,801	7,496	98,190	20,931	--
1,353	--	--	--	11,668	134,879	500	--	--
--	--	--	21,336	16,280	--	429,809	--	--
1,353	--	--	119,801	1,470,954	188,868	531,154	20,931	--
--	--	--	--	1,896	--	--	539,470	69,748
--	--	--	--	--	--	--	8,778	136,647
--	--	--	--	20,523	--	--	49,760	30,170
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	1,288	3,248
--	--	--	--	22,419	--	--	599,296	239,813
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
252,858	52,069	80,870	127,265	1,499,033	305,086	628,247	620,227	239,813

Table 4--Log flows by county and out-of-State origins,

(Thousand board feet,

Resource area and county of use	Southwest			Central				
	Douglas	Jackson	Josephine	Crook	Deschutes	Jefferson	Klamath	Lake
Northwest								
Clackamas	--	--	--	--	--	--	--	--
Clatsop and Columbia[1]	--	--	--	--	--	--	--	--
Hood River	--	--	--	--	--	--	--	--
Marion	--	--	--	--	--	--	--	--
Multnomah	--	--	--	--	--	18	--	--
Polk	--	--	--	--	--	--	--	--
Tillamook	--	--	--	--	--	--	--	--
Washington	--	--	--	--	38	--	--	--
Yamhill	--	--	--	--	--	--	--	--
Total	--	--	--	--	38	18	--	--
West Central[2]								
Benton	--	--	--	--	--	--	--	--
Lane	197,375	--	--	--	6,000	--	7,812	--
Lincoln	204	--	--	--	--	--	--	--
Linn	4,513	--	--	--	--	--	--	--
Total	202,092	--	--	--	6,000	--	7,812	--
Southwest[3]								
Coos	177,421	1,050	5,499	--	--	--	170	--
Curry	103	--	--	--	--	--	--	--
Douglas	944,849	24,309	47,508	--	--	--	5,800	--
Jackson	41,902	387,858	19,394	--	--	--	55,057	--
Josephine	2,248	47,546	71,787	--	--	--	5,210	--
Total	1,166,523	460,763	144,188	--	--	--	66,237	--
Central								
Crook	--	--	--	91,457	--	--	--	--
Deschutes and Lake[1]	--	--	--	5,553	103,088	63,704	13,537	80,723
Jefferson, Wasco, and Wheeler[1]	--	--	--	--	--	84,788	--	--
Klamath	--	4,568	--	--	9,910	--	292,820	216,676
Total	--	4,568	--	97,010	112,998	148,492	306,357	297,399
Blue Mountain								
Baker and Wallowa[1]	--	--	--	--	--	--	--	--
Grant and Harney[1]	--	--	--	9,900	1,100	--	--	2,200
Umatilla and Morrow[1]	--	--	--	--	--	--	--	--
Union	--	--	--	--	--	--	--	--
Total	--	--	--	9,900	1,100	--	--	2,200
All Areas	1,368,615	465,331	144,188	106,910	120,136	148,510	380,406	299,599

[1] Combined to avoid disclosure.

[2] Includes one post, pole, and piling plant from Central Oregon; combined to avoid disclosure.

[3] Includes one shake and shingle mill from Blue Mountain; combined to avoid disclosure.

resource area, and county of use, Oregon, 1976--Continued

Scribner log rule)

Wasco	Wheeler	Blue Mountain							Out-of-State
		Baker	Grant	Harney	Morrow	Umatilla	Union	Wallowa	
1,723	--	--	--	--	--	--	--	--	11,715
--	--	--	--	--	--	--	--	--	173,258
3,925	--	--	--	--	--	--	--	--	40,273
--	--	--	--	--	--	--	--	--	--
2,154	--	--	--	--	--	--	--	--	52,468
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	206
--	--	--	--	--	--	--	--	--	--
7,802	--	--	--	--	--	--	--	--	277,920
--	--	--	--	--	--	--	--	--	1,400
--	--	--	--	--	--	--	--	--	4,953
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	1,594
--	--	--	--	--	--	--	--	--	7,947
--	--	--	--	--	--	--	--	--	2,533
--	--	--	--	--	--	--	--	--	11,373
--	--	--	--	--	--	--	--	--	740
--	--	--	--	--	--	--	--	--	52,760
--	--	--	--	--	--	--	--	--	15,499
--	--	--	--	--	--	--	--	--	82,905
243	11,307	--	13,190	2,164	--	--	--	--	--
6,923	--	--	--	--	--	--	--	--	--
84,638	22,314	--	1,594	--	7,970	--	--	--	1,617
--	--	--	--	--	--	--	--	--	45,673
91,804	33,621	--	14,784	2,164	7,970	--	--	--	47,290
--	--	80,120	--	--	--	--	11,674	47,699	--
--	--	--	171,631	85,150	--	3,671	--	--	--
--	15,967	--	52,767	--	34,971	39,396	12,433	6,000	--
--	--	4,955	8,021	--	--	26,592	90,417	49,099	--
--	15,967	85,075	232,419	85,150	34,971	69,659	114,524	102,798	--
99,606	49,588	85,075	247,203	87,314	42,941	69,659	114,524	102,798	416,062

Table 5—Log flow to mills from National Forests, by resource area and county, Oregon, 1976

(Thousand board feet, Scribner log rule)

Resource area and county of use	All National Forests	Deschutes	Fremont	Malheur	Mt. Hood	Ochoco	Rogue River	Siskiyou	Siuslaw	Umatilla	Umpqua	Wallowa-Whitman	Willamette	Winema	Out-of-State National Forests
Northwest															
Clackamas	157,242	--	--	--	152,285	--	--	--	2,201	--	--	--	--	--	2,756
Clatsop and Columbia[1/]	53,375	--	--	--	25,304	--	--	--	--	--	--	--	--	--	28,071
Hood River	51,515	--	--	--	43,705	--	--	--	--	--	--	--	--	--	7,810
Marion	38,611	--	--	--	--	--	--	--	--	--	--	--	38,611	--	--
Multnomah	69,581	--	--	--	60,351	--	--	--	475	--	--	--	1,148	--	7,607
Polk	48,963	--	--	--	--	--	--	--	48,963	--	--	--	--	--	--
Tillamook	13,640	--	--	--	--	--	--	--	13,640	--	--	--	--	--	--
Washington	70	--	--	--	--	--	--	--	25	--	--	--	--	--	45
Yamhill	38,434	--	--	--	--	--	--	--	38,434	--	--	--	--	--	--
Total	471,431	--	--	--	281,645	--	--	--	103,738	--	--	--	39,759	--	46,289
West Central															
Benton	59,615	--	--	--	--	--	--	--	59,615	--	--	--	--	--	--
Lane	665,284	25,428	--	--	--	--	--	--	155,356	--	41,385	--	436,012	7,103	--
Lincoln	42,159	--	--	--	--	--	--	--	42,039	--	--	--	120	--	--
Linn	214,414	--	--	--	1,440	--	--	--	3,314	--	--	--	209,660	--	--
Total	981,472	25,428	--	--	1,440	--	--	--	260,324	--	41,385	--	645,792	7,103	--
Southwest															
Coos	66,947	--	--	--	--	--	490	37,136	24,222	--	1,255	--	500	--	3,344
Curry	83,964	--	--	--	--	--	--	83,964	--	--	--	--	--	--	--
Douglas	354,489	--	--	--	--	--	10,183	22,098	3,053	--	309,325	--	4,175	5,655	--
Jackson	258,430	--	--	--	--	--	170,870	573	--	--	41,744	--	--	34,055	11,188
Josephine	58,631	--	--	--	--	--	8,282	44,300	--	--	997	--	--	221	4,831
Total	822,461	--	--	--	--	--	189,825	188,071	27,275	--	353,321	--	4,675	39,931	19,363
Central															
Crook	105,926	--	--	7,673	506	97,747	--	--	--	--	--	--	--	--	--
Deschutes	176,196	147,803	23,564	--	--	4,191	--	--	--	--	--	--	--	638	--
Klamath	233,457	41,000	78,705	--	--	--	--	--	--	--	--	--	--	80,919	32,833
Lake	61,527	--	61,527	--	--	--	--	--	--	--	--	--	--	--	--
Jefferson, Wasco, and Wheeler[1/]	61,886	--	--	--	47,520	--	--	--	--	14,345	--	--	--	--	21
Total	638,992	188,803	163,796	7,673	48,026	101,938	--	--	--	14,345	--	--	--	81,557	32,854
Blue Mountain															
Baker and Wallowa[1/]	105,522	--	--	--	--	--	--	--	--	7,875	--	97,647	--	--	--
Grant and Harney[1/]	255,597	1,584	990	191,503	--	51,134	--	--	--	10,386	--	--	--	--	--
Umatilla and Morrow[1/]	95,704	--	--	--	--	--	--	--	--	90,304	--	5,400	--	--	--
Union	102,893	--	--	--	--	--	--	--	--	49,014	--	53,879	--	--	--
Total	559,716	1,584	990	191,503	--	51,134	--	--	--	157,579	--	156,926	--	--	--
All Areas	3,474,072	215,815	164,786	199,176	331,111	153,072	189,825	188,071	391,336	171,924	394,706	156,926	690,226	128,591	98,506

[1/] Combined to avoid disclosure.

Table 6—Log flow to mills from National Forests, by industry and resource area, 1976

(Thousand board feet, Scribner log rule)

Resource area and industry	All National Forests	Deschutes	Fremont	Malheur	Mt. Hood	Ochoco	Rogue River	Siskiyou	Siuslaw	Umatilla	Umpqua	Wallowa-Whitman	Willamette	Winema	Out-of-State National Forests
Northwest															
Lumber	322,523	--	--	--	211,993	--	--	--	78,527	--	--	--	1,240	--	30,763
Veneer and plywood	136,504	--	--	--	60,587	--	--	--	24,623	--	--	--	37,371	--	13,923
Shake and shingle	1,286	--	--	--	483	--	--	--	563	--	--	--	--	--	240
Export	9,808	--	--	--	7,342	--	--	--	--	--	--	--	1,148	--	1,318
Post, pole, and piling	1,310	--	--	--	1,240	--	--	--	25	--	--	--	--	--	45
Total	471,431	--	--	--	281,645	--	--	--	103,738	--	--	--	39,759	--	46,289
West Central															
Lumber	484,546	--	--	--	1,440	--	--	--	147,531	--	25,396	--	308,560	1,619	--
Veneer and plywood	491,026	25,428	--	--	--	--	--	--	109,150	--	15,989	--	334,975	5,484	--
Shake and shingle	4,814	--	--	--	--	--	--	--	3,363	--	--	--	1,451	--	--
Export	400	--	--	--	--	--	--	--	280	--	--	--	120	--	--
Post, pole, and piling[1/]	707	--	--	--	--	--	--	--	--	--	--	--	686	--	21
Total	981,493	25,428	--	--	1,440	--	--	--	260,324	--	41,385	--	645,792	7,103	21
Southwest															
Lumber	377,589	--	--	--	--	--	72,632	122,089	6,044	--	129,838	--	3,770	23,853	19,363
Veneer and plywood	415,402	--	--	--	--	--	116,703	51,936	8,052	--	222,228	--	405	16,078	--
Pulp and board	600	--	--	--	--	--	--	600	--	--	--	--	--	--	--
Shake and shingle[2/]	1,210	--	--	--	--	--	--	10	--	1,200	--	--	--	--	--
Export	28,860	--	--	--	--	--	490	13,436	13,179	--	1,255	--	500	--	--
Total	823,661	--	--	--	--	--	189,825	188,071	27,275	1,200	353,321	--	4,675	39,931	19,363
Central															
Lumber	561,019	164,552	150,180	7,673	48,026	97,747	--	--	--	14,345	--	--	--	60,353	18,143
Veneer and plywood	77,952	24,251	13,616	--	--	4,191	--	--	--	--	--	--	--	21,204	14,690
Post, pole, and piling[1/]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	638,971	188,803	163,796	7,673	48,026	101,938	--	--	--	14,345	--	--	--	81,557	32,833
Blue Mountain															
Lumber	425,476	1,594	990	147,954	--	38,048	--	--	--	118,431	--	118,459	--	--	--
Veneer and plywood	133,050	--	--	43,549	--	13,086	--	--	--	37,948	--	38,467	--	--	--
Shake and shingle[2/]		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	558,526	1,594	990	191,503	--	51,134	--	--	--	156,379	--	156,926	--	--	--
All Areas															
Lumber	2,171,153	166,146	151,170	155,627	261,459	135,795	72,632	122,089	232,102	132,776	155,234	118,459	313,570	85,825	68,269
Veneer and plywood	1,253,934	49,679	13,616	43,549	60,587	17,277	116,703	51,936	141,825	37,948	238,217	38,467	372,751	42,766	28,613
Pulp and board	600	--	--	--	--	--	--	600	--	--	--	--	--	--	--
Shake and shingle	7,310	--	--	--	483	--	--	10	3,926	1,200	--	--	1,451	--	240
Export	39,068	--	--	--	7,342	--	490	13,436	13,459	--	1,255	--	1,768	--	1,318
Post, pole, and piling	2,017	--		--	1,240	--	--	--	25	--	--	--	686	--	66
Total	3,474,082	215,825	164,786	199,176	331,111	153,072	189,825	188,071	391,337	171,924	394,706	156,926	690,226	128,591	98,506

[1/] West Central and Central combined to avoid disclosure.

[2/] Southwest and Blue Mountain combined to avoid disclosure.

Table 7--Dependency of mills for logs by ownership

(Number

Resource area and industry	National Forest				State				Bureau of Land Management			
	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100
Northwest												
Lumber	37	15	10	8	46	21	2	1	45	23	2	--
Veneer and plywood	8	5	4	4	11	8	2	--	13	8	--	--
Pulp and board	12	--	--	--	10	2	--	--	10	2	--	--
Shake and shingle	11	2	--	2	12	2	1	--	11	3	--	1
Export	12	4	--	--	10	4	2	--	16	--	--	--
Post, pole, and piling	1	2	--	1	3	1	--	--	4	--	--	--
Total	81	28	14	15	92	38	7	1	99	36	2	1
West Central												
Lumber	17	17	18	15	51	13	3	--	31	27	7	2
Veneer and plywood	20	5	15	13	49	3	1	--	27	21	5	--
Shake and shingle	18	4	3	1	24	2	--	--	21	4	1	--
Export	2	1	--	--	3	--	--	--	2	1	--	--
Post, pole, and piling	1	2	--	1	3	1	--	--	2	2	--	--
Total	58	29	36	30	130	19	4	--	83	55	13	2
Southwest												
Lumber	17	17	13	7	45	7	2	--	18	19	11	6
Veneer and plywood	20	10	12	2	38	6	--	--	20	14	6	4
Pulp and board	6	1	--	--	7	--	--	--	6	1	--	--
Shake and shingle	3	1	--	--	4	--	--	--	3	--	--	1
Export	3	3	2	1	9	--	--	--	7	2	--	--
Total	49	32	27	10	103	13	2	--	54	36	17	11
Central												
Lumber	7	1	1	20	28	1	--	--	26	3	--	--
Veneer and plywood	3	1	2	3	9	--	--	--	7	1	1	--
Post, pole, and piling	--	1	--	--	--	1	--	--	1	--	--	--
Total	10	3	3	23	37	2	--	--	34	4	1	--
Blue Mountain												
Lumber	4	2	6	11	23	--	--	--	20	3	--	--
Veneer and plywood	--	--	2	3	5	--	--	--	3	2	--	--
Shake and shingle	--	--	--	1	1	--	--	--	1	--	--	--
Total	4	2	8	15	29	--	--	--	24	5	--	--
All Areas												
Lumber	82	52	48	61	193	42	7	1	140	75	20	8
Veneer and plywood	51	21	35	25	112	17	3	--	70	46	12	4
Pulp and board	18	1	--	--	17	2	--	--	16	3	--	--
Shake and shingle	32	7	3	4	41	4	1	--	36	7	1	2
Export	17	8	2	1	22	4	2	--	25	3	--	--
Post, pole, and piling	2	5	--	2	6	3	--	--	7	2	--	--
Total	202	94	88	93	391	72	13	1	294	136	33	14

origin, resource area, and industry, Oregon, 1976

of mills)

Other public				Forest industry								Farmer and miscellaneous private			
				Own lands				Other industry							
Dependency (percent)															
0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100
61	8	1	--	49	10	5	6	33	13	9	15	30	26	5	9
16	5	--	--	12	3	6	--	11	7	--	3	12	9	--	--
11	1	--	--	9	--	--	3	10	2	--	--	9	3	--	--
15	--	--	--	13	—	--	2	11	1	--	3	13	2	--	--
15	--	1	--	15	--	1	--	3	--	2	11	10	5	--	1
4	--	--	--	4	--	--	--	3	--	--	1	1	1	--	2
122	14	2	--	102	13	12	11	71	23	11	33	75	46	5	12
65	1	1	--	45	15	3	4	30	27	4	6	31	25	4	7
52	1	--	--	34	7	7	5	36	11	5	1	39	12	1	1
25	--	--	1	26	--	--	--	14	1	4	7	17	6	1	2
3	--	--	--	3	--	--	--	--	--	1	2	2	1	--	--
4	--	--	--	2	1	1	--	1	2	1	--	1	1	1	1
149	2	1	1	110	23	11	9	81	41	15	16	90	45	7	11
54	--	--	--	31	17	3	3	26	21	3	4	30	18	4	2
44	--	--	--	25	9	5	5	29	10	5	--	30	13	--	1
7	--	--	--	6	1	--	--	6	--	--	1	6	1	--	--
4	--	--	--	4	--	--	--	2	1	--	1	3	--	--	1
[illegible]	--	--	--	8	--	1	--	2	--	2	5	7	2	--	--
118	--	--	--	74	27	9	8	65	32	10	11	76	34	4	4
24	3	--	2	18	7	1	3	23	6	--	--	18	10	1	--
8	1	--	--	6	1	--	2	7	2	--	--	5	3	--	1
1	--	--	--	--	1	--	--	--	1	--	--	--	1	--	--
33	4	--	2	24	9	1	5	30	9	--	--	23	14	1	1
23	--	--	--	13	7	2	1	16	6	1	--	6	13	1	3
4	--	1	--	3	2	--	--	4	1	--	--	--	5	--	--
1	--	--	--	1	--	--	--	1	--	--	--	1	--	--	--
28	--	1	--	17	9	2	1	21	7	1	--	7	18	1	3
227	12	2	2	156	56	74	17	128	73	17	25	115	92	15	21
124	7	1	--	80	22	18	12	87	31	10	4	86	42	1	3
18	1	--	--	15	1	--	3	16	2	--	1	15	4	--	--
45	--	--	1	44	--	--	2	28	3	4	11	34	8	1	3
27	--	1	--	26	--	2	--	5	--	5	18	19	8	--	1
9	--	--	--	6	2	1	--	4	3	1	1	2	3	1	3
450	20	4	3	327	81	35	34	268	112	37	60	271	157	18	31

Table 8—Log consumption of all mills by ownership class, resource area and industry, Oregon, 1976

(Thousand board feet, Scribner log rule)

Resource area and industry	All owners	State	National Forest	Bureau of Land Management	Other public	Forest industry		Farmer and miscellaneous private
						Own wood supply	Other wood supply	
Northwest								
Lumber	1,150,666	128,080	322,523	89,500	31,354	245,573	214,673	118,963
Veneer and plywood	404,617	57,134	136,504	33,620	7,874	93,014	49,363	27,108
Pulp and board	56,000	640	—	640	1,200	48,240	1,920	3,360
Shake and shingle	6,553	151	1,286	505	—	413	4,141	57
Export	338,690	26,588	9,808	--	5,093	9,000	179,476	108,725
Post, pole, and piling	19,345	545	1,310	--	--	--	4,865	12,625
Total	1,975,871	213,138	471,431	124,265	45,521	396,240	454,438	270,838
West Central								
Lumber	1,420,698	36,053	484,546	157,478	26,831	398,780	165,424	151,586
Veneer and plywood	1,177,643	16,654	491,026	141,387	2,527	291,477	179,532	55,040
Shake and shingle	26,814	296	4,814	1,883	22	--	12,416	7,383
Export	20,920	--	400	500	--	—	19,620	400
Post, pole, and piling[1]	6,328	95	707	230	--	1,605	986	2,705
Total	2,652,403	53,098	981,493	301,478	29,380	691,862	377,978	217,114
Southwest								
Lumber	1,278,974	47,220	377,589	389,101	--	267,354	124,687	73,023
Veneer and plywood	1,349,277	16,869	415,402	393,190	--	353,686	101,530	68,600
Pulp and board	15,000	--	600	450	—	300	13,350	300
Shake and shingle[2]	3,949	--	1,210	40	--	—	2,354	345
Export	134,944	--	28,860	1,147	—	6,912	88,457	9,568
Total	2,782,144	64,089	823,661	783,928	--	628,252	330,378	151,836
Central								
Lumber	986,698	3,850	561,019	2,932	97,750	292,542	14,682	13,923
Veneer and plywood	187,725	--	77,952	11,521	5,256	69,062	3,843	20,091
Post, pole, and piling[1]	--	--	--	--	--	--	--	--
Total	1,174,423	3,850	638,971	14,453	103,006	361,604	18,525	34,014
Blue Mountain								
Lumber	567,320	--	425,466	3,909	--	62,473	17,991	57,481
Veneer and plywood	186,443	—	133,050	4,523	21,251	13,335	2,706	11,578
Shake and shingle[2]	--	--	--	--	--	—	--	--
Total	753,763	--	558,516	8,432	21,251	75,808	20,697	69,059
All Areas								
Lumber	5,404,356	215,203	2,171,143	642,920	155,935	1,266,722	537,457	414,976
Veneer and plywood	3,305,705	90,657	1,253,934	584,241	36,908	820,574	336,974	182,417
Pulp and board	71,000	640	600	1,090	1,200	48,540	15,270	3,660
Shake and shingle	37,316	447	7,310	2,428	22	413	18,911	7,785
Export	495,554	26,588	39,068	1,647	5,093	15,912	287,553	118,693
Post, pole, and piling	25,673	640	2,017	230	--	1,605	5,851	15,330
Total	9,338,604	334,175	3,474,072	1,232,556	199,158	2,153,766	1,202,016	742,861

[1] West Central and Central combined to avoid disclosure.

[2] Southwest and Blue Mountain combined to avoid disclosure.

Table 9—Log consumption by mills by species, resource area, and industry, Oregon, 1976

(Thousand board feet, Scribner log rule)

Resource area and industry	All species	Douglas-fir	Hemlock	True firs	Spruce	Ponderosa pine	Lodgepole pine	Western redcedar	Other softwoods	Hardwoods
Northwest										
Lumber	1,150,666	673,718	403,968	10,048	14,600	1,000	4,573	18,974	2,956	20,829
Veneer and plywood	404,617	302,033	38,283	7,160	46,957	2,098	160	216	4,876	2,834
Pulp and board	56,000	13,450	39,940	580	580	--	--	--	--	1,450
Shake and shingle	6,553	--	--	--	--	--	--	6,553	--	--
Export	338,690	103,727	191,255	7,244	28,778	1,363	255	3,755	1,855	458
Post, pole, and piling	19,345	18,066	695	--	--	--	39	545	--	--
Total	1,975,871	1,110,994	674,141	250,032	90,915	4,461	5,027	30,043	9,687	25,571
West Central										
Lumber	1,420,698	1,039,617	271,543	24,665	1,837	--	2,192	59,462	4,136	17,246
Veneer and plywood	1,177,643	1,079,523	64,026	10,165	5,515	1,320	11,814	1,208	3,925	147
Shake and shingle	26,814	--	--	--	--	--	--	26,814	--	--
Export	20,920	9,151	10,187	300	1,282	--	--	--	--	--
Post, pole, and piling[1]	6,328	6,224	--	--	--	35	--	69	--	--
Total	2,652,403	2,134,515	345,756	35,130	8,634	1,355	14,006	87,553	8,061	17,393
Southwest										
Lumber	1,278,974	836,646	79,228	82,492	2,014	140,598	5,906	43,700	80,870	7,520
Veneer and plywood	1,349,277	1,166,024	55,084	76,108	6,963	9,466	412	5,342	29,878	--
Pulp and board	15,000	--	--	--	--	--	--	--	--	15,000
Shake and shingle[2]	3,949	--	--	--	--	--	--	2,749	1,200	--
Export	134,944	75,157	20,528	2,164	3,080	310	--	1,008	32,697	--
Total	2,782,144	2,077,827	154,840	160,764	12,057	150,374	6,318	52,799	144,645	22,520
Central										
Lumber	986,698	90,610	13,844	69,714	--	750,843	56,810	--	4,877	--
Veneer and plywood	187,725	46,994	3,902	93,623	735	20,596	21,875	--	--	--
Post, pole, and piling[1]	--	--	--	--	--	--	--	--	--	--
Total	1,174,423	137,604	17,746	163,337	735	771,439	78,685	--	4,877	--
Blue Mountain										
Lumber	567,320	80,617	--	91,720	8,825	327,514	33,816	--	24,816	12
Veneer and plywood	186,443	90,614	--	52,365	1,082	27,989	--	--	14,393	--
Shake and shingle[2]	--	--	--	--	--	--	--	--	--	--
Total	753,763	171,231	--	144,085	9,907	355,503	33,816	--	39,209	12
All Areas										
Lumber	5,404,356	2,721,208	768,583	278,639	27,276	1,219,955	103,297	122,136	117,655	45,607
Veneer and plywood	3,305,705	2,685,188	161,295	239,421	61,252	61,469	34,261	6,766	53,072	2,981
Pulp and board	71,000	13,450	39,940	580	580	--	--	--	--	16,450
Shake and shingle	37,316	--	--	--	--	--	--	36,116	1,200	--
Export	494,554	188,035	221,970	9,708	33,140	1,673	255	4,763	34,552	458
Post, pole, and piling	25,673	24,290	695	--	--	35	39	614	--	--
Total	9,338,604	5,632,171	1,192,483	528,348	122,248	1,283,132	137,852	170,395	206,479	65,496

---

[1] West Central and Central combined to avoid disclosure.

[2] Southwest and Blue Mountain combined to avoid disclosure.

Table 10—Production and disposition of wood and bark residues by mills by use, resource area, and residue-producing industry, Oregon, 1976

(Tons, dry weight)

Resource area and residue-producing industry	All residues	Wood residue						Bark residue					
		All wood	Used[1]				Unused	All bark	Used[1]				Unused
			Total	Pulp and board	Fuel	Miscellaneous			Total	Pulp and board	Fuel	Miscellaneous	
Northwest													
Lumber	2,062,920	1,623,886	1,608,011	1,304,883	252,454	50,674	15,875	439,034	425,027	3,309	276,576	145,142	14,007
Veneer and plywood	965,324	758,399	719,889	460,318	152,621	106,950	38,510	206,925	169,921	--	127,707	42,214	37,004
Shake and shingle	11,336	8,427	2,854	--	502	2,352	5,573	2,909	549	--	130	419	2,360
Total	3,039,580	2,390,712	2,330,754	1,765,201	405,577	159,976	59,958	648,868	595,497	3,309	404,413	187,775	53,371
West Central													
Lumber	2,382,987	1,866,194	1,866,194	1,478,051	353,889	34,254	--	516,793	516,793	3,632	441,422	71,739	--
Veneer and plywood	2,425,450	1,901,148	1,895,039	1,326,239	217,392	351,408	6,109	524,302	518,219	8,675	449,252	60,292	6,083
Shake and shingle	29,841	21,099	14,153	3,178	6,846	4,129	6,946	8,742	4,866	385	4,069	412	3,876
Total	4,838,278	3,788,441	3,775,386	2,807,468	578,127	389,791	13,055	1,049,837	1,039,878	12,692	894,743	132,443	9,959
Southwest													
Lumber	2,165,753	1,697,077	1,625,668	1,376,328	193,148	56,192	71,409	468,676	387,653	2,248	338,128	47,277	81,023
Veneer and plywood	2,648,121	2,119,385	2,115,911	1,511,727	182,770	421,414	3,474	528,736	477,820	--	414,171	63,649	50,916
Shake and shingle[2]	3,707	2,757	2,405	--	2,163	242	352	950	718	--	624	94	232
Total	4,817,581	3,819,219	3,743,984	2,888,055	378,081	477,848	75,235	998,362	866,191	2,248	752,923	111,020	132,171
Central													
Lumber	1,253,388	1,021,454	1,002,113	681,025	290,511	30,577	19,341	231,934	212,779	--	163,750	49,029	19,155
Veneer and plywood	321,872	252,381	244,971	198,354	14,911	31,706	7,410	69,491	54,727	--	49,267	5,460	14,764
Total	1,575,260	1,273,835	1,247,084	879,379	305,422	62,283	26,751	301,425	267,506	--	213,017	54,489	33,919
Blue Mountain													
Lumber	779,625	627,750	556,968	375,499	162,477	18,992	70,782	151,875	121,117	2,280	114,928	3,909	30,758
Veneer and plywood	332,681	259,799	248,330	167,805	68,012	12,513	11,469	72,882	60,199	--	60,199	--	12,683
Shake and shingle[2]	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	1,112,306	887,549	805,298	543,304	230,489	31,505	82,251	224,757	181,316	2,280	175,127	2,909	43,441
All Areas													
Lumber	8,644,673	6,836,361	6,658,954	5,215,786	1,252,479	190,689	177,407	1,808,312	1,663,369	11,469	1,334,804	317,096	144,943
Veneer and plywood	6,693,448	5,291,112	5,224,140	3,664,443	635,706	923,991	66,972	1,402,336	1,280,886	8,675	1,100,596	171,615	121,450
Shake and shingle	44,884	32,283	19,412	3,178	9,511	6,723	12,871	12,601	6,133	385	4,823	925	6,468
Total	15,383,005	12,159,756	11,902,506	8,883,407	1,897,696	1,121,403	257,250	3,223,249	2,950,388	20,529	2,440,223	489,636	272,861

[1] Used residues were not necessarily consumed in the area in which they were produced; included are residues exported from Oregon.

[2] Southwest and Blue Mountain combined to avoid disclosure.

Table 11--*Number of sawmills by mill-size class, resource area, and county, Oregon, 1976*

Resource area and county	All classes	Mill-size class[1/] D	C	B	A
Northwest					
Clackamas	15	6	4	1	4
Clatsop	2	1	--	--	1
Columbia	9	2	1	2	4
Hood River	3	--	--	--	3
Marion	6	2	1	2	1
Multnomah	4	--	1	1	2
Polk	8	1	2	1	4
Tillamook	6	4	--	--	2
Washington	10	7	1	1	1
Yamhill	7	4	--	1	2
Total	70	27	10	9	24
West Central					
Benton	10	2	3	2	3
Lane	38	3	9	10	16
Lincoln	6	2	--	2	2
Linn	13	3	4	3	3
Total	67	10	16	17	24
Southwest					
Coos	12	2	1	4	5
Curry	4	1	1	--	2
Douglas	23	2	5	5	11
Jackson	9	--	--	6	3
Josephine	6	1	--	1	4
Total	54	6	7	16	25
Central					
Crook	6	1	1	3	1
Deschutes	3	1	--	1	1
Jefferson	2	--	--	1	1
Klamath	10	--	3	2	5
Lake	5	--	2	3	--
Wasco	2	--	--	1	1
Wheeler	1	--	--	--	1
Total	29	2	6	11	10
Blue Mountain					
Baker	2	1	--	--	1
Grant	6	2	2	2	--
Harney	2	--	1	--	1
Morrow	1	--	1	--	--
Umatilla	4	--	--	3	1
Union	5	2	1	--	2
Wallowa	3	1	1	1	--
Total	23	6	6	6	5
All Areas	243	51	45	59	88

[1/] Mill-size class are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

Table 12--*Installed 8-hour capacity of sawmills by mill-size class, resource area, and county, Oregon, 1976*

(Thousand board feet, lumber tally)

Resource area and county	Total capacity	Mill-size class[1]			
		D	C	B	A
Northwest					
Clackamas	1,391	91	230	100	970
Clatsop	236	16	--	--	220
Columbia	1,011	26	50	180	755
Hood River	505	--	--	--	505
Marion	395	30	60	180	125
Multnomah	460	--	50	100	310
Polk	805	10	110	80	605
Tillamook	376	51	--	--	325
Washington	364	94	50	100	120
Yamhill	557	82	--	100	375
Total	6,100	400	550	840	4,310
West Central					
Benton	905	60	185	180	480
Lane	5,176	51	530	910	3,685
Lincoln	465	24	--	170	271
Linn	1,067	79	247	315	426
Total	7,613	214	962	1,575	4,862
Southwest					
Coos	1,524	42	50	362	1,070
Curry	385	30	60	--	295
Douglas	2,390	15	325	455	1,595
Jackson	1,150	--	--	550	600
Josephine	980	30	--	100	850
Total	6,429	117	435	1,467	4,410
Central					
Crook	520	5	75	290	150
Deschutes	472	35	--	100	337
Jefferson	205	--	--	80	125
Klamath	1,328	--	190	175	963
Lake	415	--	115	300	--
Wasco	260	--	--	110	150
Wheeler	150	--	--	--	150
Total	3,350	40	380	1,055	1,875
Blue Mountain					
Baker	132	2	--	--	130
Grant	349	14	135	200	--
Harney	262	--	45	--	217
Morrow	70	--	70	--	--
Umatilla	435	--	--	310	125
Union	435	45	50	--	340
Wallowa	166	12	54	100	--
Total	1,849	73	354	610	812
All Areas	25,341	844	2,681	5,547	16,269

---

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

Table 13--*Number of sawmills by mill-size class, resource area, and selected equipment, Oregon, 1976*

Resource area and selected equipment	All classes	Mill-size class[1]			
		D	C	B	A
Northwest					
Barker	45	6	8	7	24
Chipper	52	12	10	7	23
Planer	48	9	9	6	24
Burner	7	--	1	2	4
Kiln	24	3	2	1	18
West Central					
Barker	59	4	15	16	24
Chipper	65	8	16	17	24
Planer	54	4	13	15	22
Burner	--	--	--	--	--
Kiln	28	2	4	5	17
Southwest					
Barker	47	2	7	14	24
Chipper	49	4	7	14	24
Planer	48	1	7	16	24
Burner	11	--	--	3	8
Kiln	24	--	3	11	10
Central					
Barker	26	--	6	10	10
Chipper	26	--	6	10	10
Planer	26	1	5	10	10
Burner	6	--	2	2	2
Kiln	24	1	3	11	9
Blue Mountain					
Barker	13	--	4	4	5
Chipper	15	--	5	5	5
Planer	17	3	4	5	5
Burner	10	3	4	1	2
Kiln	11	--	4	2	5
All Areas					
Barker	190	12	40	51	87
Chipper	207	24	44	53	86
Planer	193	18	38	52	85
Burner	34	3	7	8	16
Kiln	111	6	16	30	59

---

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

Table 14--*Number of sawmills by selected equipment, resource area, and county, Oregon, 1976*

Resource area and county	Barker	Chipper	Planer	Burner	Kiln
Northwest					
Clackamas	11	11	11	2	4
Clatsop	1	2	2	--	1
Columbia	7	7	6	2	2
Hood River	3	3	3	1	3
Marion	3	5	4	--	2
Multnomah	3	3	4	--	3
Polk	6	8	7	1	3
Tillamook	3	5	3	1	2
Washington	4	3	4	--	2
Yamhill	4	5	4	--	2
Total	45	52	48	7	24
West Central					
Benton	9	10	7	--	2
Lane	34	37	33	--	20
Lincoln	5	6	4	--	--
Linn	11	12	10	--	6
Total	59	65	54	--	28
Southwest					
Coos	10	11	10	--	1
Curry	4	4	2	1	--
Douglas	21	21	21	5	13
Jackson	7	8	9	1	8
Josephine	5	5	6	4	2
Total	47	49	48	11	24
Central					
Crook	5	5	6	--	6
Deschutes	2	2	2	1	2
Jefferson	2	2	2	2	2
Klamath	10	10	10	--	8
Lake	4	4	3	2	4
Wasco	2	2	2	1	1
Wheeler	1	1	1	--	1
Total	26	26	26	6	24
Blue Mountain					
Baker	1	1	1	1	1
Grant	3	3	2	3	2
Harney	1	2	2	--	1
Morrow	1	1	1	--	1
Umatilla	2	3	4	1	2
Union	3	3	5	3	3
Wallowa	2	2	2	2	1
Total	13	15	17	10	11
All Areas	190	207	193	34	111

Table 15—Number of sawmills by type and size of headrig,[1] resource area, and mill-size class, Oregon, 1976

Resource area and mill-size class[2]	Circular saw				Band saw				Gang saw			Chipping saw			Scragg double-cut saw		
	2 ft.	4 ft.	6 ft.	8+ ft.	4 ft.	6 ft.	8 ft.	10+ ft.	2 ft.	3 ft.	4 ft.	2 ft.	3 ft.	4 ft.	2 ft.	3 ft.	4 ft.
Northwest																	
D	2	12	10	--	1	--	--	--	2	--	--	--	--	--	1	--	--
C	--	1	2	--	--	6	--	--	--	--	--	--	--	--	2	--	--
B	1	1	--	--	3	3	--	--	--	--	--	2	--	--	1	--	--
A	1	1	--	--	5	14	2	1	2	4	--	4	1	--	3	--	--
Total	4	15	12	--	9	23	2	1	4	4	--	6	1	--	7	--	--
West Central																	
D	--	4	2	--	1	2	--	--	1	--	--	1	--	--	--	--	--
C	1	--	1	1	1	6	--	--	--	--	--	1	--	1	4	--	--
B	--	1	--	--	1	12	1	1	1	--	--	--	--	--	2	--	--
A	2	--	2	--	--	14	4	--	1	3	--	2	--	--	1	--	--
Total	3	5	5	1	3	34	5	1	3	3	--	4	--	1	7	--	--
Southwest																	
D	--	4	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--
C	--	--	2	--	1	3	1	--	--	--	--	--	--	--	--	--	--
B	--	2	--	--	--	6	3	3	--	1	--	2	--	--	1	--	--
A	1	1	1	1	1	10	6	3	2	--	1	2	--	1	2	1	--
Total	1	7	3	1	2	21	10	6	2	1	1	4	--	1	3	1	--
Central																	
D	--	--	1	--	--	1	--	--	--	--	--	--	--	--	--	--	--
C	--	--	--	--	1	2	--	1	1	--	--	--	--	--	1	--	1
B	--	1	--	--	1	8	1	--	--	--	--	1	--	--	--	--	--
A	--	--	--	--	1	6	2	1	--	--	--	1	--	--	--	--	--
Total	--	1	1	--	3	17	3	2	1	--	--	2	--	--	1	--	1
Blue Mountain																	
D	--	3	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--
C	--	--	1	--	--	2	2	--	--	--	1	1	--	--	--	--	--
B	--	1	2	--	--	2	1	--	1	--	--	--	--	--	2	1	--
A	--	1	--	--	1	3	--	--	1	--	--	--	--	--	2	--	--
Total	--	5	6	--	1	7	3	--	2	--	1	1	--	--	4	1	--
All Areas																	
D	2	23	16	--	2	5	--	--	3	--	--	1	--	--	1	--	--
C	1	1	6	1	3	19	3	1	1	--	1	2	--	1	7	--	1
B	1	6	2	--	5	31	6	4	2	1	--	5	--	--	6	1	--
A	4	3	3	1	8	47	14	5	6	7	1	9	1	1	8	1	--
Total	8	33	27	2	18	102	23	10	12	8	2	17	1	2	22	2	1

---

[1] Sizes of headrigs are upper limits. Thus, the 6-foot size class includes saws 49 through 72 inches.

[2] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

Table 16--*Number of sawmills by years of tenure of present ownership, years at present site, and mill-size class, Oregon, 1976*

Mill-size class[1] and years at present site	All mills	Tenure of present mill ownership (years)				
		0-2	3-5	6-10	11-20	21+
D:						
0- 2	2	2	--	--	--	--
3- 5	4	--	4	--	--	--
6-10	6	--	2	4	--	--
11-20	23	2	--	--	21	--
21+	16	--	2	1	2	11
Total	51	4	8	5	23	11
C:						
0- 2	3	3	--	--	--	--
3- 5	3	--	3	--	--	--
6-10	1	--	--	1	--	--
11-20	13	1	1	3	7	1
21+	25	3	2	1	4	15
Total	45	7	6	5	11	16
B:						
0- 2	2	2	--	--	--	--
3- 5	1	--	1	--	--	--
6-10	6	--	1	5	--	--
11-20	12	3	3	2	3	1
21+	38	1	4	6	7	20
Total	59	6	9	13	10	21
A:						
0- 2	2	2	--	--	--	--
3- 5	3	--	3	--	--	--
6-10	3	--	--	3	--	--
11-20	17	1	2	1	12	1
21+	63	2	5	10	11	35
Total	88	5	10	14	23	36
All Classes						
0- 2	9	9	--	--	--	--
3- 5	11	--	11	--	--	--
6-10	16	--	3	13	--	--
11-20	65	7	6	6	43	3
21+	142	6	13	18	24	81
Total	243	22	33	37	67	84

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

Table 17--*Average number of operating days of sawmills by resource area and mill-size class, Oregon, 1976*

Resource area	Average number of operating days per year				
	Mill-size class[1]				Average all classes
	D	C	B	A	
Northwest	182	161	243	240	207
West Central	204	228	221	229	223
Southwest	204	230	216	239	227
Central	140	180	245	247	225
Blue Mountain	129	231	251	254	214
All Areas	181	207	227	238	219

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

Table 18—Wood consumption by sawmills by type of material consumed, resource area, and mill-size class, Oregon, 1976

(Thousand board feet, Scribner log rule)

Resource area and mill-size class[1/]	All wood	Roundwood			Other	
		All roundwood	Sound logs	Utility logs	Peeler cores	Cants
Northwest						
D	50,004	40,519	39,889	630	4,684	4,801
C	80,263	75,763	44,273	31,490	4,500	--
B	129,704	102,271	77,471	24,800	27,433	--
A	967,193	932,113	909,178	22,935	35,080	--
Total	1,227,164	1,150,666	1,070,811	79,855	71,697	4,801
West Central						
D	44,904	29,579	23,979	5,600	7,500	7,825
C	154,164	138,717	124,003	14,714	15,447	--
B	329,715	279,815	223,172	56,643	49,900	--
A	1,004,608	972,587	882,428	90,159	32,021	--
Total	1,533,391	1,420,698	1,253,582	167,116	104,868	7,825
Southwest						
D	12,245	12,245	10,045	2,200	--	--
C	72,363	66,650	57,232	9,418	2,880	2,833
B	352,064	340,509	298,486	42,023	11,555	--
A	952,905	859,570	770,207	89,363	93,335	--
Total	1,389,577	1,278,974	1,135,970	143,004	107,770	2,833
Central						
D and C[2/]	94,735	87,035	78,103	8,932	7,700	--
B	217,935	214,961	207,961	7,000	2,974	--
A	684,702	684,702	678,894	5,808	--	--
Total	997,372	986,698	964,958	21,740	10,674	--
Blue Mountain						
D	4,239	4,239	3,139	1,100	--	--
C	140,402	140,402	116,902	23,500	--	--
B	114,656	114,656	111,524	3,132	--	--
A	315,640	308,023	308,023	--	7,617	--
Total	574,937	567,320	539,588	27,732	7,617	--
All Areas						
D	111,392	86,582	77,052	9,530	12,184	12,626
C	541,927	508,567	420,513	88,054	30,527	2,833
B	1,144,074	1,052,212	918,614	133,598	91,862	--
A	3,925,048	3,756,995	3,548,730	208,265	168,053	--
Total	5,722,441	5,404,356	4,964,909	439,447	302,626	15,459

[1/] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

[2/] Combined to avoid disclosure.

Table 19--*Log consumption by sawmills by timber age group, resource area, and mill-size class, Oregon, 1976*

(Thousand board feet, Scribner log rule)

Resource area and mill-size class[1]	All age groups	Old growth (100+ years)	Young growth (less than 100 years)
Northwest			
D	40,519	3,973	36,546
C	75,763	57,509	18,254
B	102,271	13,531	88,740
A	932,113	281,633	650,480
Total	1,150,666	356,646	794,020
West Central			
D	29,579	5,400	24,179
C	138,717	70,022	68,695
B	279,815	165,369	114,446
A	972,587	773,464	199,123
Total	1,420,698	1,014,255	406,443
Southwest			
D	12,245	1,850	10,395
C	66,650	41,717	24,933
B	340,509	276,940	63,569
A	859,570	658,555	201,015
Total	1,278,974	979,062	299,912
Central Oregon			
D and C[2]	87,035	81,226	5,809
B	214,961	174,810	40,151
A	684,702	567,905	116,797
Total	986,698	823,941	162,757
Blue Mountain			
D	4,239	1,093	3,146
C	140,402	116,345	24,057
B	114,656	85,798	28,858
A	308,023	261,561	46,462
Total	567,320	464,797	102,523
All Areas			
D	86,582	12,316	74,266
C	508,567	366,819	141,748
B	1,052,212	716,448	335,764
A	3,756,995	2,543,118	1,213,877
Total	5,404,356	3,638,701	1,765,655

---

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

[2] Combined to avoid disclosure.

Table 20--*Log consumption by sawmills by timber age group, resource area, and county, Oregon, 1976*

(Thousand board feet, Scribner log rule)

Resource area and county	All age groups	Old growth (100+ years)	Young growth (less than 100 years)
Northwest			
Clackamas	291,865	111,189	180,676
Clatsop and Columbia[1]	241,142	69,323	171,819
Hood River	92,253	47,068	45,185
Marion	55,440	4,320	51,120
Multnomah	84,696	73,226	11,470
Polk	140,149	42,995	97,154
Tillamook	105,136	1,439	103,697
Washington	51,955	3,785	48,170
Yamhill	88,030	3,301	84,729
Total	1,150,666	356,646	794,020
West Central			
Benton	139,708	60,210	79,498
Lane	977,608	795,704	181,904
Lincoln	74,641	51,599	23,042
Linn	228,741	106,742	121,999
Total	1,420,698	1,014,255	406,443
Southwest			
Coos	382,805	256,275	126,530
Curry	65,090	61,134	3,956
Douglas	519,915	412,771	107,144
Jackson	185,338	129,819	55,519
Josephine	125,826	119,063	6,763
Total	1,278,974	979,062	299,912
Central			
Crook	118,727	107,671	11,056
Deschutes	171,500	115,320	56,180
Jefferson, Wheeler, and Wasco[1]	176,627	158,044	18,583
Klamath	458,157	391,922	66,235
Lake	61,687	50,984	10,703
Total	986,698	823,941	162,757
Blue Mountain			
Baker and Wallowa[1]	110,495	71,292	39,203
Grant and Harney[1]	214,590	192,307	22,283
Umatilla and Morrow[1]	117,261	88,883	28,378
Union	124,974	112,315	12,659
Total	567,320	464,797	102,523
All Areas	5,404,356	3,638,701	1,765,655

[1] Combined to avoid disclosure.

Table 21--*Log inventory changes, log consumption, and apparent log receipts by sawmills, by resource area, Oregon, 1976*

(Thousand board feet, Scribner log rule)

Resource area	Log inventory			1976 log consumption	Apparent 1976 log receipts
	January 1, 1976	December 31, 1976	Net change		
Northwest	217,154	247,708	30,554	1,150,666	1,181,220
West Central	191,925	217,559	25,634	1,420,698	1,446,332
Southwest	279,887	288,717	8,830	1,278,974	1,287,804
Central	203,751	211,066	7,315	986,698	994,013
Blue Mountain	118,517	124,817	6,300	567,320	573,620
All Areas	1,011,234	1,089,867	78,633	5,404,356	5,482,989

Table 22—Log consumption by sawmills by ownership class, resource area, and mill-size class, Oregon, 1976

(Thousand board feet, Scribner log rule)

Resource area and mill-size class[1/]	All owners	State	National Forest	Bureau of Land Management	Other public	Forest industry		Farmer and miscellaneous private
						Own wood supply	Other wood supply	
Northwest								
D	40,519	1,330	12,767	1,737	49	1,613	15,415	7,608
C	75,763	3,100	13,596	1,582	—	1,860	21,537	34,088
B	102,271	5,392	19,016	8,856	1,030	3,191	57,562	7,224
A	932,113	118,258	277,144	77,325	30,275	238,909	120,159	70,043
Total	1,150,666	128,080	322,523	89,500	31,354	245,573	214,673	118,963
West Central								
D	29,579	3,840	6,346	3,187	--	3,376	7,922	4,908
C	138,717	6,030	46,924	14,059	—	6,779	28,499	36,426
B	279,815	7,959	102,133	78,038	--	11,864	22,799	57,022
A	972,587	18,224	329,143	62,194	26,831	376,761	106,204	53,230
Total	1,420,698	36,053	484,546	157,478	26,831	398,780	165,424	151,586
Southwest								
D	12,245	1,800	455	205	--	600	4,395	4,790
C	66,650	—	21,875	14,385	--	9,795	12,165	8,430
B	340,509	1,290	93,305	100,639	--	71,057	48,166	26,052
A	859,570	44,130	261,954	273,872	--	185,902	59,961	33,751
Total	1,278,974	47,220	377,589	389,101	--	267,354	124,687	73,023
Central								
D and C[2/]	87,035	--	48,275	—	—	33,092	2,376	3,292
B	214,961	--	193,040	243	7,938	1,368	6,056	6,316
A	684,702	3,850	319,704	2,689	89,812	258,082	6,250	4,315
Total	986,698	3,850	561,019	2,932	97,750	292,542	14,682	13,923
Blue Mountain								
D	4,239	--	1,818	--	--	20	--	2,401
C	140,402	--	108,520	--	—	15,419	4,619	11,844
B	114,656	--	83,011	720	--	4,934	5,812	20,179
A	308,023	--	232,117	3,189	--	42,100	7,560	23,057
Total	567,320	--	425,466	3,909	—	62,473	17,991	57,481
All Areas								
D	86,582	6,970	21,386	5,129	49	5,609	27,732	19,707
C	508,567	9,130	239,190	30,026	—	66,945	69,196	94,080
B	1,052,212	14,641	490,505	188,496	8,968	92,414	140,395	116,793
A	3,756,995	184,462	1,420,062	419,269	146,918	1,101,754	300,134	184,396
Total	5,404,356	215,203	2,171,143	642,920	155,935	1,266,722	537,457	414,976

[1/] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

[2/] Combined to avoid disclosure.

Table 23—Log consumption by sawmills by ownership class, resource area, and county, Oregon, 1976

(Thousand board feet, Scribner log rule)

Resource area and county	All owners	State	National Forest	Bureau of Land Management	Other public	Forest industry		Farmer and miscellaneous private
						Own wood supply	Other wood supply	
Northwest								
Clackamas	291,865	4,055	131,889	18,882	7,649	45,033	40,893	43,464
Clatsop and Columbia[1/]	241,142	58,911	14,533	2,693	1,967	118,672	25,967	18,399
Hood River	92,253	13,126	51,515	875	17,809	6,000	370	2,558
Marion	55,440	3,800	1,240	1,010	--	--	35,310	14,080
Multnomah	84,696	9,837	47,011	1,406	1,876	5,628	16,000	2,938
Polk	140,149	6,935	37,300	28,126	1,023	22,163	36,664	7,938
Tillamook	105,136	23,399	13,640	9,468	--	32,917	23,625	2,087
Washington	51,955	6,500	--	8,975	1,030	4,700	12,330	18,420
Yamhill	88,030	1,517	25,395	18,065	--	10,460	23,514	9,079
Total	1,150,666	128,080	322,523	89,500	31,354	245,573	214,673	118,963
West Central								
Benton	139,708	5,500	59,390	15,392	--	--	14,751	44,675
Lane	977,608	8,551	313,049	118,907	24,924	362,540	91,726	57,911
Lincoln	74,641	13,252	28,760	1,430	1,907	21,558	5,259	2,475
Linn	228,741	8,750	83,347	21,749	--	14,682	53,688	46,525
Total	1,420,698	36,053	484,546	157,478	26,831	398,780	165,424	151,586
Southwest								
Coos	382,805	36,935	22,735	84,791	—	177,443	33,459	27,442
Curry	65,090	--	53,975	4,950	--	202	3,163	2,800
Douglas	519,915	8,065	153,331	222,236	--	60,193	43,758	32,332
Jackson	185,338	2,220	95,717	40,740	--	21,932	15,929	8,800
Josephine	125,826	--	51,831	36,384	--	7,584	28,378	1,649
Total	1,278,974	47,220	377,589	389,101	--	267,354	124,687	73,023
Central								
Crook	118,727	--	105,926	243	--	3,616	3,526	5,416
Deschutes	171,500	--	147,665	--	1,620	17,810	3,490	915
Jefferson, Wasco, and Wheeler[1/]	176,627	--	61,865	--	96,130	15,741	--	2,891
Klamath	458,157	3,850	186,276	2,689	--	255,375	7,666	2,301
Lake	61,687	--	59,287	--	--	--	--	2,400
Total	986,698	3,850	561,019	2,932	97,750	292,542	14,682	13,923
Blue Mountain								
Baker and Wallowa[1/]	110,495	--	80,872	--	--	6,871	659	22,093
Grant and Harney[1/]	214,590	--	199,044	720	--	3,096	7,601	4,129
Umatilla and Morrow[1/]	117,261	--	74,582	--	--	26,513	4,416	11,750
Union	124,974	--	70,968	3,189	--	25,993	5,315	19,509
Total	567,320	--	425,466	3,909	--	62,473	17,991	57,481
All Areas	5,404,356	215,203	2,171,143	642,920	155,935	1,266,722	537,457	414,976

[1/] Combined to avoid disclosure.

Table 24--Dependency of sawmills for logs by ownership

(Number

Resource area and mill-size class[1/]	National Forest				State				Bureau of Land Management			
	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100
Northwest												
D	20	3	2	2	23	4	--	--	23	3	1	--
C	5	3	1	1	9	--	1	--	7	3	--	--
B	6	1	1	1	5	4	--	--	5	4	--	--
A	6	8	6	4	9	13	1	1	10	13	1	--
Total	37	15	10	8	46	21	2	1	45	23	2	--
West Central												
D	4	4	1	1	7	1	2	--	6	3	1	--
C	6	3	4	3	14	1	1	--	9	6	1	--
B	3	5	6	3	11	6	--	--	5	6	4	2
A	4	5	7	8	19	5	--	--	11	12	1	--
Total	17	17	18	15	51	13	3	--	31	27	7	2
Southwest												
D	4	2	--	--	5	1	--	--	5	1	--	--
C	2	1	2	2	7	--	--	--	2	3	2	--
B	4	5	6	1	15	1	--	--	5	6	4	1
A	7	9	5	4	18	5	2	--	6	9	5	5
Total	17	17	13	7	45	7	2	--	18	19	11	6
Central												
D and C[2/]	3	--	--	5	8	--	--	--	8	--	--	--
B	1	1	--	9	11	--	--	--	10	1	--	--
A	3	--	1	6	9	1	--	--	8	2	--	--
Total	7	1	1	20	28	1	--	--	26	3	--	--
Blue Mountain												
D	3	1	--	2	6	--	--	--	6	--	--	--
C	1	--	3	2	6	--	--	--	6	--	--	--
B	--	1	--	5	6	--	--	--	5	1	--	--
A	--	--	3	2	5	--	--	--	3	2	--	--
Total	4	2	6	11	23	--	--	--	20	3	--	--
All Areas												
D	31	10	3	5	41	6	2	--	40	7	2	--
C	17	7	10	13	44	1	2	--	32	12	3	--
B	14	13	13	19	48	11	--	--	30	18	8	3
A	20	22	22	24	60	24	3	1	38	38	7	5
Total	82	52	48	61	193	42	7	1	140	75	20	8

[1/] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D - less than 40,000.

[2/] Combined to avoid disclosure.

origin, resource area, and mill-size class, Oregon, 1976

of mills)

Other public				Forest industry								Farmer and miscellaneous private			
				Own lands				Other industry							
Dependency (percent)															
0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100
26	1	--	--	23	1	--	3	14	1	4	8	13	5	4	5
10	--	--	--	8	1	--	1	5	1	1	3	5	3	--	2
8	1	--	--	8	1	--	--	3	3	--	3	6	2	1	--
17	6	1	--	10	7	5	2	11	8	4	1	6	16	--	2
61	8	1	--	49	10	5	6	33	13	9	15	30	26	5	9
10	--	--	--	8	--	2	--	6	2	--	2	1	7	--	2
16	--	--	--	11	4	--	1	6	7	2	1	6	6	1	3
17	--	--	--	12	5	--	--	10	5	1	1	9	5	1	2
22	1	1	--	14	6	1	3	8	13	1	2	15	7	2	--
65	1	1	--	45	15	3	4	30	27	4	6	31	25	4	7
6	--	--	--	5	--	1	--	2	2	1	1	2	2	--	2
7	--	--	--	5	1	1	--	5	1	--	1	3	2	2	--
16	--	--	--	7	6	1	2	6	9	--	1	8	8	--	--
25	--	--	--	14	10	--	1	13	9	2	1	17	6	2	--
54	--	--	--	31	17	3	3	26	21	3	4	30	18	4	2
8	--	--	--	5	2	--	1	6	2	--	--	4	4	--	--
8	2	--	1	9	2	--	--	9	2	--	--	7	3	1	--
8	1	--	1	4	3	1	2	8	2	--	--	7	3	--	--
24	3	--	2	18	7	1	3	23	6	--	--	18	10	1	--
6	--	--	--	5	--	--	1	6	--	--	--	2	2	--	2
6	--	--	--	3	2	1	--	4	1	1	--	3	2	1	--
6	--	--	--	4	2	--	--	4	2	--	--	1	4	--	1
5	--	--	--	1	3	1	--	2	3	--	--	--	5	--	--
23	--	--	--	13	7	2	1	16	6	1	--	6	13	1	3
48	1	--	--	41	1	3	4	28	5	5	11	18	16	4	11
47	--	--	--	32	10	2	3	26	12	4	5	21	17	4	5
55	3	--	1	40	16	1	2	32	21	1	5	31	22	3	3
77	8	2	1	43	29	8	8	42	35	7	4	45	37	4	2
227	12	2	2	156	56	14	17	128	73	17	25	115	92	15	21

Table 25—Log consumption by sawmills by species, resource area, and mill-size class, Oregon, 1976

(Thousand board feet, Scribner log rule)

Resource area and mill-size class[1]	All species	Douglas-fir	Hemlock	True firs	Spruce	Ponderosa pine	Lodgepole pine	Western redcedar	Other softwoods	Hardwoods
Northwest										
D	40,519	12,988	4,275	235	14	--	--	2,158	20	20,829
C	75,763	45,491	19,011	3,526	760	1,000	--	5,975	--	--
B	102,271	70,127	27,565	1,615	--	--	--	2,964	--	--
A	932,113	545,112	353,117	4,672	13,826	--	4,573	7,877	2,936	--
Total	1,150,666	673,718	403,968	10,048	14,600	1,000	4,573	18,974	2,956	20,829
West Central										
D	29,579	4,878	1,322	--	--	--	--	6,133	--	17,246
C	138,717	96,954	8,400	3,118	194	--	--	26,199	3,852	--
B	279,815	217,540	50,110	7,994	284	--	--	3,603	284	--
A	972,587	720,245	211,711	13,553	1,359	--	2,192	23,527	--	--
Total	1,420,698	1,039,617	271,543	24,665	1,837	--	2,192	59,462	4,136	17,246
Southwest										
D	12,245	2,275	380	145	350	80	--	485	1,010	7,520
C	66,650	35,724	6,888	4,128	--	1,200	--	16,190	2,520	--
B	340,509	181,044	15,572	30,796	--	70,939	4,281	6,771	31,106	--
A	859,570	617,603	56,388	47,423	1,664	68,379	1,625	20,254	46,234	--
Total	1,278,974	836,646	79,228	82,492	2,014	140,598	5,906	43,700	80,870	7,520
Central										
D and C[2]	87,035	2,956	--	4,797	--	74,080	2,400	--	2,802	--
B	214,961	15,714	4,604	13,237	--	175,081	6,325	--	--	--
A	684,702	71,940	9,240	51,680	--	501,682	48,085	--	2,075	--
Total	986,698	90,610	13,844	69,714	--	750,843	56,810	--	4,877	--
Blue Mountain										
D	4,239	1,663	--	299	120	977	110	--	1,058	12
C	140,402	18,617	--	20,872	2,204	89,218	2,314	--	7,177	--
B	114,656	24,448	--	18,791	650	61,560	8,007	--	1,200	--
A	308,023	35,889	--	51,758	5,851	175,759	23,385	--	15,381	--
Total	567,320	80,617	--	91,720	8,825	327,514	33,816	--	24,816	12
All Areas										
D	86,582	21,804	5,977	679	484	1,057	110	8,776	2,088	45,607
C	508,567	199,742	34,299	36,441	3,158	165,498	4,714	48,364	16,351	--
B	1,052,212	508,873	97,851	72,433	934	307,580	18,613	13,338	32,590	--
A	3,756,995	1,990,789	630,456	169,086	22,700	745,820	79,860	51,658	66,626	--
Total	5,404,356	2,721,208	768,583	278,639	27,276	1,219,955	103,297	122,136	117,655	45,607

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

[2] Combined to avoid disclosure.

Table 26—Log consumption by sawmills by species, resource area, and type of material, Oregon, 1976

(Thousand board feet, Scribner log rule)

Resource area and type of material	All species	Douglas-fir	Hemlock	True firs	Spruce	Ponderosa pine	Lodgepole pine	Western redcedar	Other softwoods	Hardwoods
Northwest										
Sound[1]/	1,070,809	627,993	373,557	9,881	13,684	1,000	4,306	17,202	2,857	20,329
Utility	79,857	45,725	30,411	167	916	--	267	1,772	99	500
Total	1,150,666	673,718	403,968	10,048	14,600	1,000	4,573	18,974	2,956	20,829
West Central										
Sound[1]/	1,253,583	919,683	235,734	18,261	1,837	--	1,892	56,369	3,761	16,046
Utility	167,115	119,934	35,809	6,404	--	--	300	3,093	375	1,200
Total	1,420,698	1,039,617	271,543	24,665	1,837	--	2,192	59,462	4,136	17,246
Southwest										
Sound[1]/	1,135,970	732,904	66,022	75,970	1,655	137,270	1,625	36,795	77,209	6,520
Utility	143,004	103,742	13,206	6,522	359	3,328	4,281	6,905	3,661	1,000
Total	1,278,974	836,646	79,228	82,492	2,014	140,598	5,906	43,700	80,870	7,520
Central										
Sound[1]/	964,958	90,367	13,844	66,563	--	734,656	55,069	--	4,459	--
Utility	21,740	243	--	3,151	--	16,187	1,741	--	418	--
Total	986,698	90,610	13,844	69,714	--	750,843	56,810	--	4,877	--
Blue Mountain										
Sound[1]/	539,599	77,117	--	90,760	8,725	304,981	33,597	--	24,407	12
Utility	27,721	3,500	--	960	100	22,533	219	--	409	--
Total	567,320	80,617	--	91,720	8,825	327,514	33,816	--	24,816	12
All Areas										
Sound[1]/	4,964,919	2,448,064	689,157	261,435	25,901	1,177,907	96,489	110,366	112,693	42,907
Utility	439,437	273,144	79,426	17,204	1,375	42,048	6,808	11,770	4,962	2,700
Total	5,404,356	2,721,208	768,583	278,639	27,276	1,219,955	103,297	122,136	117,655	45,607

[1] Includes both live and dead logs.

Table 27—Log consumption by sawmills by species, resource area, and county, Oregon, 1976

(Thousand board feet, Scribner log rule)

Resource area and county	All species	Douglas-fir	Hemlock	True firs	Spruce	Ponderosa pine	Lodgepole pine	Western redcedar	Other softwoods	Hardwoods
Northwest										
Clackamas	291,865	204,278	71,093	3,391	760	--	3,570	8,753	20	--
Clatsop and Columbia[1]	241,142	111,664	112,829	--	6,010	--	--	3,448	2,381	4,810
Hood River	92,253	54,797	32,369	3,330	832	--	--	370	555	--
Marion	55,440	27,230	21,630	470	--	--	--	2,370	--	3,740
Multnomah	84,696	65,271	13,268	1,000	906	1,000	1,003	2,248	--	--
Polk	140,149	81,298	55,593	829	829	--	--	--	--	1,600
Tillamook	105,136	31,153	58,867	--	4,908	--	--	--	--	10,208
Washington	51,955	43,250	6,405	515	--	--	--	1,785	--	--
Yamhill	88,030	54,777	31,914	513	355	--	--	--	--	471
Total	1,150,666	673,718	403,968	10,048	14,600	1,000	4,573	18,974	2,956	20,829
West Central										
Benton	139,708	119,297	2,863	218	194	--	--	6,836	--	10,300
Lane	977,608	761,160	152,217	5,015	1,250	--	2,192	50,104	3,750	1,920
Lincoln	74,641	69,682	378	--	109	--	--	272	--	4,200
Linn	228,741	89,478	116,085	19,432	284	--	--	2,250	386	826
Total	1,420,698	1,039,617	271,543	24,665	1,837	--	2,192	59,462	4,136	17,246
Southwest										
Coos	382,805	345,858	18,498	2,159	1,764	--	--	7,976	--	6,550
Curry	65,090	62,890	250	125	250	--	--	450	1,000	125
Douglas	519,915	315,249	45,345	23,757	--	62,021	4,281	35,239	33,178	845
Jackson	185,338	21,674	8,092	45,568	--	75,061	1,000	--	33,943	--
Josephine	125,826	90,975	7,043	10,883	--	3,516	625	35	12,749	--
Total	1,278,974	836,646	79,228	82,492	2,014	140,598	5,906	43,700	80,870	7,520
Central										
Crook	118,727	16,217	3,039	2,087	--	97,084	--	--	300	--
Deschutes	171,500	--	--	4,110	--	149,580	17,810	--	--	--
Jefferson, Wheeler, and Wasco[1]	176,627	60,773	10,805	20,131	--	84,918	--	--	--	--
Klamath	458,157	13,620	--	27,599	--	375,761	36,600	--	4,577	--
Lake	61,687	--	--	15,787	--	43,500	2,400	--	--	--
Total	986,698	90,610	13,844	69,714	--	750,843	56,810	--	4,877	--
Blue Mountain										
Baker and Wallowa[1]	110,495	27,042	--	23,403	1,859	54,390	3,142	--	659	--
Grant and Harney[1]	214,590	10,702	--	7,022	--	187,887	4,779	--	4,200	--
Umatilla and Morrow[1]	117,261	24,350	--	18,976	1,548	59,753	5,149	--	7,485	--
Union	124,974	18,523	--	42,319	5,418	25,484	20,746	--	12,472	12
Total	567,320	80,617	--	91,720	8,825	327,514	33,816	--	24,816	12
All Areas	5,404,356	2,721,208	768,583	278,639	27,276	1,219,955	103,297	122,136	117,655	45,607

[1] Combined to avoid disclosure.

Table 28—Production and disposition of wood and bark residues by sawmills, by resource area and mill-size class, Oregon, 1976

(Tons, dry weight)

Resource area and mill-size class[1]	All residues			Wood residue			Bark residue		
	Total	Used[2]	Unused	Total	Used[2]	Unused	Total	Used[2]	Unused
Northwest									
D	56,723	49,110	7,613	44,319	39,545	4,774	12,404	9,565	2,839
C	99,191	99,191	--	78,204	78,204	--	20,987	20,987	--
B	183,501	179,406	4,095	147,515	145,960	1,555	35,986	33,446	2,540
A	1,723,505	1,705,331	18,174	1,353,848	1,344,302	9,546	369,657	361,029	8,628
Total	2,062,920	2,033,038	29,882	1,623,886	1,608,011	15,875	439,034	425,027	14,007
West Central									
D	47,987	47,987	--	36,443	36,443	--	11,544	11,544	--
C	243,974	243,974	--	189,633	189,633	--	54,341	54,341	--
B	465,876	465,876	--	367,036	367,036	--	98,840	98,840	--
A	1,625,150	1,625,150	--	1,273,082	1,273,082	--	352,068	352,068	--
Total	2,382,987	2,382,987	--	1,866,194	1,866,194	--	516,793	516,793	--
Southwest									
D	13,028	11,917	1,111	9,760	8,972	788	3,268	2,945	323
C	118,205	118,205	--	91,623	91,623	--	26,582	26,582	--
B	584,781	522,987	61,794	458,650	422,166	36,484	126,131	100,821	25,310
A	1,449,739	1,360,212	89,527	1,137,044	1,102,907	34,137	312,695	257,305	55,390
Total	2,165,753	2,013,321	152,432	1,697,077	1,625,668	71,409	468,676	387,653	81,023
Central									
D and C[3]	111,656	103,025	8,631	91,259	85,888	5,371	20,397	17,137	3,260
B	280,426	279,465	961	230,742	229,781	961	49,684	49,684	--
A	861,306	832,402	28,904	699,453	686,444	13,009	161,853	145,958	15,895
Total	1,253,388	1,214,892	38,496	1,021,454	1,002,113	19,341	231,934	212,779	19,155
Blue Mountain									
D	4,320	501	3,819	3,381	383	2,998	939	118	821
C	178,547	139,080	39,467	141,779	118,342	23,437	36,768	20,738	16,030
B	141,936	113,883	28,053	114,290	95,857	18,433	27,646	18,026	9,620
A	454,822	424,621	30,201	368,300	342,386	25,914	86,522	82,235	4,287
Total	779,625	678,085	101,540	627,750	556,968	70,782	151,875	121,117	30,758
All Areas									
D	122,058	109,515	12,543	93,903	85,343	8,560	28,155	24,172	3,983
C	751,573	703,475	48,098	592,498	563,690	28,808	159,075	139,785	19,290
B	1,656,520	1,561,617	94,903	1,318,233	1,260,800	57,433	338,287	300,817	37,470
A	6,114,522	5,947,716	166,806	4,831,727	4,749,121	82,606	1,282,795	1,198,595	84,200
Total	8,644,673	8,322,323	322,350	6,836,361	6,658,954	177,407	1,808,312	1,663,369	144,943

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

[2] Residues not necessarily consumed in the area in which they were produced.

[3] Combined to avoid disclosure.

Table 29—Production and disposition of wood residue by sawmills, by type of residue use, resource area, and mill-size class, Oregon, 1976

(Tons, dry weight)

Resource area and mill-size class[1]	All types							Coarse[2]						
	Total	Total used[3]	Pulp	Board	Fuel	Miscellaneous	Unused	Total	Total used[3]	Pulp	Board	Fuel	Miscellaneous	Unused
Northwest														
D	44,319	39,545	26,165	2,951	6,121	4,308	4,774	26,187	23,341	17,664	1,658	2,871	1,148	2,846
C	78,204	78,204	39,159	5,037	22,528	11,480	--	44,351	44,351	37,716	1,339	3,990	1,307	--
B	147,515	145,960	91,740	19,351	22,054	12,815	1,555	83,584	83,584	69,305	4,000	10,279	--	--
A	1,353,848	1,344,302	930,212	190,369	201,651	22,071	9,546	755,063	754,313	661,458	28,958	63,127	770	750
Total	1,623,886	1,608,011	1,087,276	217,607	252,454	50,674	15,875	909,185	905,589	786,143	35,954	80,267	3,225	3,596
West Central														
D	36,443	36,443	19,956	8,976	4,436	3,075	--	22,502	22,502	19,632	2,372	447	51	--
C	189,633	189,633	120,014	27,604	40,053	1,962	--	109,318	109,318	107,184	--	2,134	--	--
B	367,036	367,036	227,269	62,967	52,872	23,928	--	208,155	208,155	197,099	--	4,206	6,850	--
A	1,273,082	1,273,082	741,108	270,157	256,528	5,289	--	711,071	711,071	707,232	--	3,839	--	--
Total	1,866,194	1,866,194	1,108,347	369,704	353,889	34,254	--	1,051,046	1,051,046	1,031,147	2,372	10,626	6,901	--
Southwest														
D	9,760	8,972	5,819	1,393	902	858	788	6,273	5,984	5,622	--	362	--	289
C	91,623	91,623	59,371	17,231	14,940	181	--	52,966	52,966	52,966	--	--	--	--
B	458,650	422,166	236,008	100,770	76,682	8,706	36,484	260,052	260,052	213,305	16,224	21,817	8,706	--
A	1,137,044	1,102,907	666,070	289,666	100,724	46,447	34,137	635,811	635,310	621,994	--	3,432	9,884	501
Total	1,697,077	1,625,668	967,268	409,060	193,148	56,192	71,409	955,102	954,312	893,887	16,224	25,611	18,590	790
Central														
D and C[4]	91,259	85,888	41,194	18,425	25,914	355	5,371	49,674	48,369	41,194	820	6,355	--	1,305
B	230,742	229,781	121,453	23,157	71,147	14,024	961	124,059	124,059	121,453	--	--	2,606	--
A	699,453	686,444	308,948	167,848	193,450	16,198	13,009	379,358	379,358	297,022	45,120	21,018	16,198	--
Total	1,021,454	1,002,113	471,595	209,430	290,511	30,577	19,341	553,091	551,786	459,669	45,940	27,373	18,804	1,305
Blue Mountain														
D	3,381	383	--	--	108	275	2,998	2,017	247	--	--	108	139	1,770
C	141,779	118,342	80,346	1,080	36,681	235	23,437	79,328	74,571	68,583	--	5,753	235	4,757
B	114,290	95,857	42,021	28,588	23,174	2,074	18,433	61,629	54,405	42,021	12,384	--	--	7,224
A	368,300	342,386	156,979	66,485	102,514	16,408	25,914	195,720	191,751	156,979	33,746	1,026	--	3,969
Total	627,750	556,968	279,346	96,153	162,477	18,992	70,782	338,694	320,974	267,583	46,130	6,887	374	17,720
All Areas														
D	93,903	85,343	51,940	13,220	11,667	8,516	8,560	56,979	52,074	42,918	4,030	3,788	1,338	4,905
C	592,498	563,690	340,084	69,377	140,016	14,213	28,808	335,637	329,575	307,643	2,158	18,232	1,542	6,062
B	1,318,233	1,260,800	718,491	234,833	245,929	61,547	57,433	737,479	730,255	643,183	32,608	36,302	19,162	7,224
A	4,831,727	4,749,121	2,803,317	984,524	854,867	106,413	82,606	2,677,023	2,671,803	2,444,685	107,824	92,442	26,852	5,220
Total	6,836,361	6,658,954	3,913,832	1,301,954	1,252,479	190,689	177,407	3,807,118	3,783,707	3,438,429	146,620	150,764	47,894	23,411

See footnotes at end of table.

Table 29—Production and disposition of wood residue by sawmills, by type of residue use, resource area, and mill-size class, Oregon, 1976—Continued

(Tons, dry weight)

Resource area and mill-size class[1]	Shavings							Sawdust						
	Total	Total used[3]	Pulp	Board	Fuel	Miscellaneous	Unused	Total	Total used[3]	Pulp	Board	Fuel	Miscellaneous	Unused
Northwest														
D	6,260	5,836	3,224	498	297	1,817	424	11,872	10,368	5,277	695	3,053	1,343	1,504
C	15,310	15,310	1,443	1,705	8,274	3,888	--	18,543	18,543	--	1,994	10,264	6,285	--
B	27,877	27,877	11,639	9,425	4,055	2,758	--	36,054	34,499	10,796	5,926	7,720	10,057	1,555
A	276,043	272,807	98,493	122,375	51,031	908	3,236	322,742	317,182	170,261	39,035	87,493	20,393	5,560
Total	325,490	321,830	114,799	134,003	63,657	9,371	3,660	389,211	380,592	186,334	47,650	108,530	38,078	8,619
West Central														
D	4,353	4,353	--	2,786	424	1,143	--	9,588	9,588	324	3,818	3,565	1,881	--
C	34,396	34,396	2,029	23,773	8,594	--	--	45,919	45,919	10,801	3,831	29,325	1,962	--
B	65,963	65,963	4,289	42,793	8,903	9,978	--	92,918	92,918	25,881	20,174	39,763	7,100	--
A	267,255	267,255	6,946	174,050	80,970	5,289	--	294,756	294,756	26,930	96,107	171,719	--	--
Total	371,967	371,967	13,264	243,402	98,891	16,410	--	443,181	443,181	63,936	123,930	244,372	10,943	--
Southwest														
D	689	689	--	464	--	225	--	2,798	2,299	197	929	540	633	499
C	16,401	16,401	--	14,963	1,257	181	--	22,256	22,256	6,405	2,268	13,583	--	--
B	89,883	89,883	16,808	66,459	6,616	--	--	108,715	72,231	5,895	18,087	48,249	--	36,484
A	223,488	223,117	5,469	191,525	5,787	20,336	371	277,745	244,480	38,607	98,141	91,505	16,227	33,265
Total	330,461	330,090	22,277	273,411	13,660	20,742	371	411,514	341,266	51,104	119,425	153,877	16,860	70,248
Central														
D and C[4]	15,933	15,933	--	15,572	6	355	--	25,652	21,586	--	2,033	19,553	--	4,066
B	42,874	42,874	--	23,157	8,299	11,418	--	63,809	62,848	--	--	62,848	--	961
A	132,687	126,419	11,926	91,264	23,229	--	6,268	187,408	180,667	--	31,464	149,203	--	6,741
Total	191,494	185,226	11,926	129,993	31,534	11,773	6,268	276,869	265,101	--	33,497	231,604	--	11,768
Blue Mountain														
D	284	--	--	--	--	--	284	1,080	136	--	--	--	136	944
C	20,977	18,883	11,763	1,080	6,040	--	2,094	41,474	24,888	--	--	24,888	--	16,586
B	21,910	19,222	--	13,462	3,686	2,074	2,688	30,751	22,230	--	2,742	19,488	--	8,521
A	72,400	72,400	--	32,739	23,253	16,408	--	100,180	78,235	--	--	78,235	--	21,945
Total	115,571	110,505	11,763	47,281	32,979	18,482	5,066	173,485	125,489	--	2,742	122,611	136	47,996
All Areas														
D	11,586	10,878	3,224	3,748	721	3,185	708	25,338	22,391	5,798	5,442	7,158	3,993	2,947
C	103,017	100,923	15,235	57,093	24,171	4,424	2,094	153,844	133,192	17,206	10,126	97,613	8,247	20,652
B	248,507	245,819	32,736	155,296	31,559	26,228	2,688	332,247	284,726	42,572	46,929	178,068	17,157	47,521
A	971,873	961,998	122,834	611,953	184,270	42,941	9,875	1,182,831	1,115,320	235,798	264,747	578,155	36,620	67,511
Total	1,334,983	1,319,618	174,029	828,090	240,721	76,778	15,365	1,694,260	1,555,629	301,374	327,244	860,994	66,017	138,631

---

[1] Mill-size classes are as follows: Class A = mills 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000

[2] Slabs, edgings, trim, and ends.

[3] Includes all residues consumed in the area in which they were produced.

[4] Combined to avoid disclosure.

Table 30—Production and disposition of bark residue by sawmills by use, resource area, and mill-size class, Oregon, 1976

(Tons, dry weight)

Resource area and mill-size class[1]	All bark	Used[2]					Unused
		Total	Pulp	Board	Fuel	Miscellaneous	
Northwest							
D	12,404	9,565	2,654	--	4,577	2,334	2,839
C	20,987	20,987	--	655	9,654	10,678	--
B	35,986	33,446	--	--	20,092	13,354	2,540
A	369,657	361,029	--	--	242,253	118,776	8,628
Total	439,034	425,027	2,654	655	276,576	145,142	14,007
West Central							
D	11,544	11,544	951	1,161	6,060	3,372	--
C	54,341	54,341	--	--	49,374	4,967	--
B	98,840	98,840	--	--	82,706	16,134	--
A	352,068	352,068	1,520	--	303,282	47,266	--
Total	516,793	516,793	2,471	1,161	441,422	71,739	--
Southwest							
D	3,268	2,945	545	--	1,626	774	323
C	26,582	26,582	--	--	23,768	2,814	--
B	126,131	100,821	--	1,703	96,280	2,838	25,310
A	312,695	257,305	--	--	216,454	40,851	55,390
Total	468,676	387,653	545	1,703	338,128	47,277	81,023
Central							
D and C[3]	20,397	17,137	--	--	17,137	--	3,260
B	49,684	49,684	--	--	47,222	2,462	--
A	161,853	145,958	--	--	99,391	46,567	15,895
Total	231,934	212,779	--	--	163,750	49,029	19,155
Blue Mountain							
D	939	118	--	--	51	67	821
C	36,768	20,738	2,280	--	18,458	--	16,030
B	27,646	18,026	--	--	14,930	3,096	9,620
A	86,522	82,235	--	--	81,489	746	4,287
Total	151,875	121,117	2,280	--	114,928	3,909	30,758
All Areas							
D	28,155	24,172	4,150	1,161	12,314	6,547	3,983
C	159,075	139,785	2,280	655	118,391	18,459	19,290
B	338,287	300,817	--	1,703	261,230	37,884	37,470
A	1,282,795	1,198,595	1,520	--	942,869	254,206	84,200
Total	1,808,312	1,663,369	7,950	3,519	1,334,804	317,096	144,943

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

[2] Residues not necessarily consumed in the area in which they were produced.

[3] Combined to avoid disclosure.

Table 31—Production and disposition of wood and bark residues by sawmills by resource area and county, Oregon, 1976

(Tons, dry weight)

Resource area and county	All residues			Wood residue			Bark residue		
	Total	Used[1]	Unused	Total	Used[1]	Unused	Total	Used[1]	Unused
Northwest									
Clackamas	484,026	483,937	89	374,472	374,394	78	109,554	109,543	11
Clatsop and Columbia[2]	435,265	434,620	645	340,027	339,939	88	95,238	94,681	557
Hood River	184,169	174,122	10,047	148,666	139,120	9,546	35,503	35,002	501
Marion	82,011	82,011	--	65,783	65,783	--	16,228	16,228	--
Multnomah	141,284	133,157	8,127	111,228	111,228	--	30,056	21,929	8,127
Polk	260,773	256,896	3,877	205,749	204,194	1,555	55,024	52,702	2,322
Tillamook	190,838	190,440	398	149,661	149,661	--	41,177	40,779	398
Washington	112,010	106,459	5,551	90,089	86,293	3,796	21,921	20,166	1,755
Yamhill	172,544	171,396	1,148	138,211	137,399	812	34,333	33,997	336
Total	2,062,920	2,033,038	29,882	1,623,886	1,608,011	15,875	439,034	425,027	14,007
West Central									
Benton	238,544	238,544	--	187,015	187,015	--	51,529	51,529	--
Lane	1,576,169	1,576,169	--	1,226,683	1,226,683	--	349,486	349,486	--
Lincoln	157,973	157,973	--	124,005	124,005	--	33,968	33,968	--
Linn	410,301	410,301	--	328,491	328,491	--	81,810	81,810	--
Total	2,382,987	2,382,987	--	1,866,194	1,866,194	--	516,793	516,793	--
Southwest									
Coos	565,438	514,262	51,176	440,480	421,842	18,638	124,958	92,420	32,538
Curry	88,193	59,286	28,907	68,147	55,049	13,098	20,046	4,237	15,809
Douglas	930,549	909,833	20,716	729,030	717,247	11,783	201,519	192,586	8,933
Jackson	351,397	334,994	16,403	280,526	264,861	15,665	70,871	70,133	738
Josephine	230,176	194,946	35,230	178,894	166,669	12,225	51,282	28,277	23,005
Total	2,165,753	2,013,321	152,432	1,697,077	1,625,668	71,409	468,676	387,653	81,023
Central									
Crook	154,679	154,679	--	124,911	124,911	--	29,768	29,768	--
Deschutes	213,484	210,506	2,978	172,125	169,922	2,203	41,359	40,584	775
Jefferson, Wheeler, and Wasco[2]	204,900	175,035	29,865	166,493	152,523	13,970	38,407	22,512	15,895
Klamath	597,523	597,523	--	491,280	491,280	--	106,243	106,243	--
Lake	82,802	77,149	5,653	66,645	63,477	3,168	16,157	13,672	2,485
Total	1,253,388	1,214,892	38,496	1,021,454	1,002,113	19,341	231,934	212,779	19,155
Blue Mountain									
Baker and Wallowa[2]	127,814	112,580	15,234	101,102	91,912	9,190	26,712	20,668	6,044
Grant and Harney[2]	272,805	255,976	16,829	220,446	211,925	8,521	52,359	44,051	8,308
Umatilla and Morrow[2]	177,718	156,698	21,020	143,265	128,482	14,783	34,453	28,216	6,237
Union	201,288	152,831	48,457	162,937	124,649	38,288	38,351	28,182	10,169
Total	779,625	678,085	101,540	627,750	556,968	70,782	151,875	121,117	30,758
All Areas	8,644,673	8,322,323	322,350	6,836,361	6,658,954	177,407	1,808,312	1,663,369	144,943

[1] Residues not necessarily consumed in the area or county in which produced.

[2] Combined to avoid disclosure.

Table 32—Production and disposition of wood residue by sawmills by type of residue, use, resource area, and county, Oregon, 1976

(Tons, dry weight)

Resource area and county	All types							Coarse[1]						
	Total	Total used[2]	Pulp	Board	Fuel	Miscellaneous	Unused	Total	Total used[2]	Pulp	Board	Fuel	Miscellaneous	Unused
Northwest														
Clackamas	374,472	374,394	276,030	14,774	57,578	26,012	78	217,645	217,575	212,796	--	3,245	1,534	70
Clatsop and Columbia[3]	340,027	339,939	325,071	13,438	579	851	88	191,451	191,390	188,656	1,782	182	770	61
Hood River	148,666	139,120	77,756	53,177	7,279	908	9,546	79,923	79,173	64,055	15,118	--	--	750
Marion	65,783	65,783	51,321	8,045	5,892	525	--	34,461	34,461	33,488	--	924	49	--
Multnomah	111,228	111,228	85,030	13,497	4,493	8,208	--	63,467	63,467	59,467	4,000	--	--	--
Polk	205,749	204,194	122,418	36,906	42,537	2,333	1,555	109,259	109,259	108,317	--	942	--	--
Tillamook	149,661	149,661	32,534	23,319	93,615	193	--	82,935	82,935	25,979	--	56,885	71	--
Washington	90,089	86,293	16,194	31,471	31,755	6,873	3,796	49,112	46,939	16,194	12,485	17,459	801	2,173
Yamhill	138,211	137,399	100,922	22,980	8,726	4,771	812	80,932	80,390	77,191	2,569	630	--	542
Total	1,623,886	1,608,011	1,087,276	217,607	252,454	50,674	15,875	909,185	905,589	786,143	35,954	80,267	3,225	3,596
West Central														
Benton	187,015	187,015	103,504	29,647	46,878	6,986	--	104,670	104,670	96,392	2,372	--	5,906	--
Lane	1,226,683	1,226,683	724,768	271,995	203,024	26,896	--	700,149	700,149	688,975	--	10,179	995	--
Lincoln	124,005	124,005	77,208	3,183	43,614	--	--	68,531	68,531	68,531	--	--	--	--
Linn	328,491	328,491	202,867	64,879	60,373	372	--	177,696	177,696	177,249	--	447	--	--
Total	1,866,194	1,866,194	1,108,347	369,704	353,889	34,254	--	1,051,046	1,051,046	1,031,147	2,372	10,626	6,901	--
Southwest														
Coos	440,480	421,842	288,060	72,735	44,606	16,441	18,638	255,803	255,803	243,796	4,920	2,167	4,920	--
Curry	68,147	55,049	42,064	10,367	2,618	--	13,098	42,064	42,064	42,064	--	--	--	--
Douglas	729,030	717,247	424,989	220,959	58,514	12,785	11,783	407,286	407,286	403,427	--	73	3,786	--
Jackson	280,526	264,861	120,421	74,271	70,169	--	15,665	147,393	147,252	112,866	11,304	23,082	--	141
Josephine	178,894	166,669	91,734	30,728	17,241	26,966	12,225	102,556	101,907	91,734	--	289	9,884	649
Total	1,697,077	1,625,668	967,268	409,060	193,148	56,192	71,409	955,102	954,312	893,887	16,224	25,611	18,590	790
Central														
Crook	124,911	124,911	69,276	8,220	38,767	8,648	--	67,059	67,059	64,438	--	15	2,606	--
Deschutes	172,125	169,922	72,093	53,361	39,092	5,376	2,203	92,939	91,634	72,093	11,529	8,012	--	1,305
Jefferson, Wheeler, and Wasco [3]	166,493	152,523	82,360	31,102	39,061	--	13,970	86,650	86,650	81,465	--	5,185	--	--
Klamath	491,280	491,280	212,473	104,203	158,051	16,553	--	270,230	270,230	206,280	33,591	14,161	16,198	--
Lake	66,645	63,477	35,393	12,544	15,540	--	3,168	36,213	36,213	35,393	820	--	--	--
Total	1,021,454	1,002,113	471,595	209,430	290,511	30,577	19,341	553,091	551,786	459,669	45,940	27,373	18,804	1,305
Blue Mountain														
Baker and Wallowa[3]	101,102	91,912	54,620	11,020	24,183	2,089	9,190	58,018	55,874	54,620	--	1,244	10	2,144
Grant and Harney[3]	220,446	211,925	118,460	11,113	82,281	71	8,521	117,786	117,002	112,378	--	4,617	7	784
Umatilla and Morrow[3]	143,265	128,482	28,525	64,230	35,727	--	14,783	76,198	68,974	22,844	46,130	--	--	7,224
Union	162,937	124,649	77,741	9,790	20,286	16,832	38,288	86,692	79,124	77,741	--	1,026	357	7,568
Total	627,750	556,968	279,346	96,153	162,477	18,992	70,782	338,694	320,974	267,583	46,130	6,887	374	17,720
All Areas	6,836,361	6,658,954	3,913,832	1,301,954	1,252,479	190,689	177,407	3,807,118	3,783,707	3,438,429	146,620	150,764	47,894	23,411

See footnotes at end of table.

Table 32—Production and disposition of wood residue by sawmills by type of residue, use, resource area, and county, Oregon, 1976—Continued

(Tons, dry weight)

Resource area and county	Shavings							Sawdust						
	Total	Total used[2]	Pulp	Board	Fuel	Miscellaneous	Unused	Total	Total used[2]	Pulp	Board	Fuel	Miscellaneous	Unused
Northwest														
Clackamas	65,105	65,105	25,043	14,774	25,237	51	--	91,722	91,714	38,191	--	29,096	24,427	8
Clatsop and Columbia[3]	68,842	68,842	63,194	5,457	191	--	--	79,734	79,707	73,221	6,199	206	81	27
Hood River	27,635	24,399	4,844	14,845	3,802	908	3,236	41,108	35,548	8,857	23,214	3,477	--	5,560
Marion	15,419	15,419	10,856	3,878	586	99	--	15,903	15,903	6,977	4,167	4,382	377	--
Multnomah	19,393	19,393	6,123	6,293	3,089	3,888	--	28,368	28,368	19,440	3,204	1,404	4,320	--
Polk	49,454	49,454	--	36,906	12,548	--	--	47,036	45,481	14,101	--	29,047	2,333	1,555
Tillamook	32,254	32,254	--	23,319	8,920	15	--	34,472	34,472	6,555	--	27,810	107	--
Washington	19,762	19,338	--	8,618	9,284	1,436	424	21,215	20,016	--	10,368	5,012	4,636	1,199
Yamhill	27,626	27,626	4,739	19,913	--	2,974	--	29,653	29,383	18,992	498	8,096	1,797	270
Total	325,490	321,830	114,799	134,003	63,657	9,371	3,660	389,211	380,592	186,334	47,650	108,530	38,078	8,619
West Central														
Benton	39,205	39,205	1,589	18,203	18,333	1,080	--	43,140	43,140	5,523	9,072	28,545	--	--
Lane	234,128	234,128	1,770	179,128	37,900	15,330	--	292,406	292,406	34,023	92,867	154,945	10,571	--
Lincoln	27,035	27,035	6,125	3,183	17,727	--	--	28,439	28,439	2,552	--	25,887	--	--
Linn	71,599	71,599	3,780	42,888	24,931	--	--	79,196	79,196	21,838	21,991	34,995	372	--
Total	371,967	371,967	13,264	243,402	98,891	16,410	--	443,181	443,181	63,936	123,930	244,372	10,943	--
Southwest														
Coos	76,882	76,882	5,657	62,404	--	8,821	--	107,795	89,157	38,607	5,411	42,439	2,700	18,638
Curry	9,300	9,300	--	9,300	--	--	--	16,783	3,685	--	1,067	2,618	--	13,098
Douglas	153,028	153,028	9,065	137,268	6,695	--	--	168,716	156,933	12,497	83,691	51,746	8,999	11,783
Jackson	57,882	57,511	7,555	42,991	6,965	--	371	75,251	60,098	--	19,976	40,122	--	15,153
Josephine	33,369	33,369	--	21,448	--	11,921	--	42,969	31,393	--	9,280	16,952	5,161	11,576
Total	330,461	330,090	22,277	273,411	13,660	20,742	371	411,514	341,266	51,104	119,425	153,877	16,860	70,248
Central														
Crook	23,380	23,380	4,838	8,220	4,280	6,042	--	34,472	34,472	--	--	34,472	--	--
Deschutes	31,296	31,296	--	22,032	3,888	5,376	--	47,890	46,992	--	19,800	27,192	--	898
Jefferson, Wheeler, and Wasco[3]	35,374	29,106	895	19,438	8,773	--	6,268	44,469	36,767	--	11,664	25,103	--	7,702
Klamath	89,720	89,720	6,193	68,579	14,593	355	--	131,330	131,330	--	2,033	129,297	--	--
Lake	11,724	11,724	--	11,724	--	--	--	18,708	15,540	--	--	15,540	--	3,168
Total	191,494	185,226	11,926	129,993	31,534	11,773	6,268	276,869	265,101	--	33,497	231,604	--	11,768
Blue Mountain														
Baker and Wallowa[3]	13,148	13,094	--	11,020	--	2,074	54	29,936	22,944	--	--	22,939	5	6,992
Grant and Harney[3]	42,732	42,372	6,282	11,113	24,977	--	360	60,128	52,751	--	--	52,687	64	7,377
Umatilla and Morrow[3]	28,041	25,353	5,681	15,358	4,314	--	2,688	39,026	34,155	--	2,742	31,413	--	4,871
Union	31,850	29,886	--	9,790	3,688	16,408	1,964	44,395	15,639	--	--	15,572	67	28,756
Total	115,771	110,705	11,963	47,281	32,979	18,482	5,066	173,485	125,489	--	2,742	122,611	136	47,996
All Areas	1,335,183	1,319,818	174,229	828,090	240,721	76,778	15,365	1,694,260	1,555,629	301,374	327,244	860,394	66,017	138,631

---

[1] Coarse residue includes slabs, edgings, sawmill trim, and planer trim.

[2] Residues not necessarily consumed in the area in which they were produced.

[3] Combined to avoid disclosure.

Table 33—Production and disposition of bark residue by sawmills by use, resource area, and county, Oregon, 1976

(Tons, dry weight)

Resource area and county	All bark	Used[1/]					Unused
		Total	Pulp	Board	Fuel	Miscellaneous	
Northwest							
Clackamas	109,554	109,543	--	--	41,241	68,302	11
Clatsop and Columbia[2/]	95,238	94,681	774	655	93,252	--	557
Hood River	35,503	35,002	--	--	34,237	765	501
Marion	16,228	16,228	1,357	--	7,301	7,570	--
Multnomah	30,056	21,929	--	--	335	21,594	8,127
Polk	55,024	52,702	413	--	34,225	18,064	2,322
Tillamook	41,177	40,779	--	--	40,254	525	398
Washington	21,921	20,166	--	--	15,068	5,098	1,755
Yamhill	34,333	33,997	110	--	10,663	23,224	336
Total	439,034	425,027	2,654	655	276,576	145,142	14,007
West Central							
Benton	51,529	51,529	--	1,161	40,409	9,959	--
Lane	349,486	349,486	2,084	--	295,814	51,588	--
Lincoln	33,968	33,968	387	--	33,581	--	--
Linn	81,810	81,810	--	--	71,618	10,192	--
Total	516,793	516,793	2,471	1,161	441,422	71,739	--
Southwest							
Coos	124,958	92,420	310	--	88,756	3,354	32,538
Curry	20,046	4,237	--	--	1,423	2,814	15,809
Douglas	201,519	192,586	235	--	164,862	27,489	8,933
Jackson	70,871	70,133	--	1,703	57,724	10,706	738
Josephine	51,282	28,277	--	--	25,363	2,914	23,005
Total	468,676	387,653	545	1,703	338,128	47,277	81,023
Central							
Crook	29,768	29,768	--	--	29,768	--	--
Deschutes	41,359	40,584	--	--	8,094	32,490	775
Jefferson, Wheeler, and Wasco[2/]	38,407	22,512	--	--	22,512	--	15,895
Klamath	106,243	106,243	--	--	89,704	16,539	--
Lake	16,157	13,672	--	--	13,672	--	2,485
Total	231,934	212,779	--	--	163,750	49,029	19,155
Blue Mountain							
Baker and Wallowa[2/]	26,712	20,668	--	--	17,572	3,096	6,044
Grant and Harney[2/]	52,359	44,051	2,280	--	41,768	3	8,308
Umatilla and Morrow[2/]	34,453	28,216	--	--	27,470	746	6,237
Union	38,351	28,182	--	--	28,118	64	10,169
Total	151,875	121,117	2,280	--	114,928	3,909	30,758
All Areas	1,808,312	1,663,369	7,950	3,519	1,334,804	317,096	144,943

[1/] Residues not necessarily consumed in the area in which they were produced.

[2/] Combined to avoid disclosure.

Table 34—Lumber production by sawmills by degree of manufacture, resource area, and mill-size class, Oregon, 1976

(Thousand board feet, lumber tally)

Resource area and mill-size class[1]	Green	Kiln-dried	Air-dried	Total	Rough	Surfaced
Northwest						
D	46,438	9,495	15	55,948	26,313	29,635
C	80,358	5,487	--	85,845	14,968	70,877
B	129,937	28,226	8,750	166,913	37,856	129,057
A	807,436	646,115	6,033	1,459,584	197,725	1,261,859
Total	1,064,169	689,323	14,798	1,768,290	276,862	1,491,428
West Central						
D	32,728	11,686	168	44,582	24,421	20,161
C	172,587	39,999	--	212,586	53,342	159,244
B	340,188	72,100	1,717	414,005	140,464	273,541
A	685,898	676,721	1,885	1,364,504	151,257	1,213,247
Total	1,231,401	800,506	3,770	2,035,677	369,484	1,666,193
Southwest						
D	12,335	325	--	12,660	9,465	3,195
C	64,260	33,121	5,653	103,034	27,125	75,909
B	273,519	161,276	68,516	503,311	87,188	416,123
A	845,114	406,871	34,004	1,285,989	251,333	1,034,656
Total	1,195,228	601,593	108,173	1,904,994	375,111	1,529,883
Central						
D and C[2]	16,962	68,238	11,963	97,163	14,171	82,992
B	19,409	202,622	19,664	241,695	18,467	223,228
A	71,218	626,269	12,396	709,883	42,173	667,710
Total	107,589	897,129	44,023	1,048,741	74,811	973,930
Blue Mountain						
D	2,314	--	1,749	4,063	2,580	1,483
C	50,731	97,963	5,118	153,812	48,069	105,743
B	11,960	64,000	43,715	119,675	6,761	112,914
A	3,587	353,220	22,662	379,469	2,391	377,078
Total	68,592	515,183	73,244	657,019	59,801	597,218
All Areas						
D	93,815	21,506	1,932	117,253	62,779	54,474
C	384,898	244,808	22,734	652,440	157,675	494,765
B	775,013	528,224	142,362	1,445,599	290,736	1,154,863
A	2,413,253	2,709,196	76,980	5,199,429	644,879	4,554,550
Total	3,666,979	3,503,734	244,008	7,414,721	1,156,069	6,258,652

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

[2] Combined to avoid disclosure.

Table 35--*Number of veneer and plywood mills by type of mill, resource area, and county, Oregon, 1976*

Resource area and county	All types	Veneer only	Layup only	Veneer and layup
Northwest				
Clackamas	4	2	2	--
Clatsop	1	--	--	1
Columbia	2	1	--	1
Marion	2	2	--	--
Multnomah	3	1	--	2
Polk	4	1	--	3
Tillamook	1	--	--	1
Washington	1	1	--	--
Yamhill	3	1	1	1
Total	21	9	3	9
West Central				
Benton	4	1	3	--
Lane	32	17	6	9
Lincoln	2	1	--	1
Linn	15	4	4	7
Total	53	23	13	17
Southwest				
Coos	9	4	1	4
Curry	3	1	--	2
Douglas	15	6	2	7
Jackson	11	2	3	6
Josephine	6	--	5	1
Total	44	13	11	20
Central				
Deschutes	1	--	--	1
Jefferson	2	1	1	--
Klamath	5	3	--	2
Lake	1	1	--	--
Total	9	5	1	3
Blue Mountain				
Baker	1	1	--	--
Grant	1	1	--	--
Harney	1	--	--	1
Morrow	1	--	--	1
Union	1	--	--	1
Total	5	2	--	3
All Areas	132	52	28	52

Table 36--*Installed 8-hour capacity of veneer and plywood mills by type of mill, resource area, and county, Oregon, 1976*

(Thousand square feet, 3/8-inch basis)

Resource area and county	Veneer only	Layup only	Veneer and layup	
			Veneer	Layup
Northwest				
Clackamas	250	197	--	--
Clatsop	--	--	90	110
Columbia	200	--	400	166
Marion	380	--	--	--
Multnomah	25	--	285	325
Polk	125	--	700	975
Tillamook	--	--	380	380
Washington	160	--	--	--
Yamhill	240	80	240	190
Total	1,380	277	2,095	2,146
West Central				
Benton	170	460	--	--
Lane	4,102	953	1,658	1,365
Lincoln	120	--	278	278
Linn	760	607	1,174	1,347
Total	5,152	2,020	3,110	2,990
Southwest				
Coos	496	540	918	967
Curry	160	--	420	320
Douglas	1,380	360	1,457	1,645
Jackson	561	676	2,038	1,750
Josephine	--	770	195	150
Total	2,597	2,346	5,028	4,832
Central				
Deschutes	--	--	150	160
Jefferson	180	180	--	--
Klamath	295	--	370	300
Lake	100	--	--	--
Total	575	180	520	460
Blue Mountain				
Baker	240	--	--	--
Grant	100	--	--	--
Harney	--	--	120	120
Morrow	--	--	312	200
Union	--	--	157	70
Total	340	--	589	390
All Areas	10,044	4,823	11,342	10,818

Table 37--*Number of veneer and plywood mills by diameter limit of lathe and resource area, Oregon, 1976*

Resource area	Lathe log diameter limit							
	Layup only	20-29	30-39	40-49	50-59	60-69	70-79	80+
Northwest	3	1	--	1	1	3	3	9
West Central	13	--	--	1	3	10	5	21
Southwest	11	--	1	--	--	9	7	16
Central	1	--	3	--	--	3	1	1
Blue Mountain	--	--	1	2	2	--	--	--
All Areas	28	1	5	4	6	25	16	47

Table 38--*Number of veneer and plywood mills by size of core produced and resource area, Oregon, 1976*

Resource area	Diameter of cores (inches)								No lathe or core
	3	4	5	6	7	8	9	10	
Northwest	--	1	5	4	6	2	--	--	3
West Central	--	1	4	11	11	10	3	--	13
Southwest	1	3	10	11	3	4	1	--	11
Central	1	2	3	1	1	--	--	--	1
Blue Mountain	--	2	2	1	--	--	--	--	--
All Areas	2	9	24	28	21	16	4	--	28

Table 39—Number of veneer and plywood mills having selected equipment by resource area, and county, Oregon, 1976

Resource area and county	4-foot lathe	8-foot lathe	Slicer	Veneer chipper	Core chipper	Cold press	Hot press	Burner
Northwest								
Clackamas	1	2	--	1	1	--	3	--
Clatsop	1	1	--	1	1	--	1	--
Columbia	--	2	--	1	--	--	1	--
Marion	--	2	--	2	2	--	--	1
Multnomah	2	2	1	2	2	--	2	--
Polk	1	4	--	4	2	--	2	--
Tillamook	--	1	--	1	--	--	1	1
Washington	--	1	--	1	--	--	--	--
Yamhill	2	2	--	2	1	--	2	--
Total	7	17	1	15	9	--	12	2
West Central								
Benton	--	1	--	2	--	--	3	--
Lane	9	26	--	26	16	--	15	--
Lincoln	2	1	--	2	2	--	1	--
Linn	3	11	--	9	3	1	11	--
Total	14	39	--	39	21	1	30	--
Southwest								
Coos	6	5	--	6	8	--	5	--
Curry	1	3	--	3	2	--	2	1
Douglas	5	13	--	13	9	--	9	2
Jackson	4	8	1	8	7	--	9	2
Josephine	1	1	--	1	1	--	5	--
Total	17	30	1	31	27	--	30	5
Central								
Deschutes	1	1	--	1	1	--	1	--
Jefferson	--	1	--	1	--	1	1	2
Klamath	3	3	1	5	3	1	2	2
Lake	1	--	--	--	1	--	--	1
Total	5	5	1	7	5	2	4	5
Blue Mountain								
Baker	1	1	--	1	1	1	--	1
Grant	1	--	--	1	1	--	--	1
Harney	--	1	--	1	--	--	1	--
Morrow	1	1	--	1	1	--	1	--
Union	--	1	--	1	1	1	1	1
Total	3	4	--	5	4	2	3	3
All Areas	46	95	3	97	66	5	79	15

Table 40--*Number of veneer and plywood mills by years of tenure of present mill ownership, resource area, and years at site, Oregon, 1976*

Resource area and years at site	All mills	Tenure of present mill ownership (years)				
		0-2	3-5	6-10	11-20	21+
Northwest						
3- 5	1	--	1	--	--	--
11-20	11	1	2	1	7	--
21+	9	1	--	2	2	4
Total	21	2	3	3	9	4
West Central						
0- 2	1	1	--	--	--	--
6-10	6	--	2	4	--	--
11-20	24	--	3	4	17	--
21+	22	--	3	4	5	10
Total	53	1	8	12	22	10
Southwest						
6-10	2	--	--	2	--	--
11-20	23	3	7	1	12	--
21+	19	2	3	4	2	8
Total	44	5	10	7	14	8
Central						
3- 5	1	--	1	--	--	--
6-10	4	1	2	1	--	--
11-20	4	--	--	2	2	--
Total	9	1	3	3	2	--
Blue Mountain						
6-10	2	--	--	2	--	--
11-20	3	--	--	--	3	--
Total	5	--	--	2	3	--
All Areas						
0- 2	1	1	--	--	--	--
3- 5	2	--	2	--	--	--
6-10	14	1	4	9	--	--
11-20	65	4	12	8	41	--
21+	50	3	6	10	9	22
Total	132	9	24	27	50	22

Table 41--*Average number of operating days of veneer and plywood mills by type of mill and resource area, Oregon, 1976*

Resource area	Veneer only	Layup only	Veneer and layup
Northwest	216	262	271
West Central	230	262	242
Southwest	254	256	248
Central	188	230	255
Blue Mountain	273	--	281
All Areas	231	258	252

Table 42--*Log consumption by veneer and plywood mills by type of material and resource area, Oregon, 1976*

(Thousand board feet, Scribner log rule)

Resource area	All types	Sound logs	Utility logs
Northwest	404,617	367,726	36,891
West Central	1,177,643	893,699	283,944
Southwest	1,349,277	1,105,541	243,736
Central	187,725	180,098	7,627
Blue Mountain	186,443	186,243	200
All Areas	3,305,705	2,733,307	572,398

Table 43--*Log consumption by veneer and plywood mills by timber age group and resource area, Oregon, 1976*

(Thousand board feet, Scribner log rule)

Resource area	All age groups	Old growth (100+ years)	Young growth (less than 100 years)
Northwest	404,617	252,605	152,012
West Central	1,177,643	908,863	268,780
Southwest	1,349,277	971,219	378,058
Central	187,725	147,909	39,816
Blue Mountain	186,443	159,324	27,119
All Areas	3,305,705	2,439,920	865,785

Table 44--*Log inventory changes, log consumption, and apparent log receipts by veneer and plywood mills by resource area, Oregon, 1976*

(Thousand board feet, Scribner log rule)

Resource area	Log inventory			1976 log consumption	Apparent 1976 log receipts
	January 1, 1976	December 31, 1976	Net change		
Northwest	93,378	87,560	-5,818	404,617	398,799
West Central	157,493	192,143	34,650	1,177,643	1,212,293
Southwest	251,323	230,881	-20,442	1,349,277	1,328,835
Central	54,934	59,380	4,446	187,725	192,171
Blue Mountain	97,772	104,571	6,799	186,443	193,242
All Areas	654,900	674,535	19,635	3,305,705	3,325,340

Table 45—Log consumption by veneer and plywood mills by ownership class, resource area, and county, Oregon, 1976

(Thousand board feet, Scribner log rule)

Resource area and county	All owners	State	National Forest	Bureau of Land Management	Other public	Forest industry		Farmer and miscellaneous private
						Own lands	Other industry	
Northwest								
Clackamas and Marion[1]	91,123	6,400	62,721	1,950	--	8,202	3,900	7,950
Clatsop and Columbia[1]	93,337	23,010	37,897	--	2,427	20,022	--	9,981
Multnomah	35,650	14,139	11,266	209	278	869	8,750	139
Polk	109,017	7,950	11,581	21,155	4,914	43,169	14,407	5,841
Tillamook, Washington, and Yamhill[1]	75,490	5,635	13,039	10,306	255	20,752	22,306	3,197
Total	404,617	57,134	136,504	33,620	7,874	93,014	49,363	27,108
West Central								
Benton and Lincoln[1]	77,259	--	12,636	8,251	--	53,011	895	2,466
Lane	779,558	2,254	347,923	96,992	2,527	205,047	106,374	18,441
Linn	320,826	14,400	130,467	36,144	--	33,419	72,263	34,133
Total	1,177,643	16,654	491,026	141,387	2,527	291,477	179,532	55,040
Southwest								
Coos	264,899	4,395	14,752	54,021	--	149,562	26,262	15,907
Curry	91,761	--	29,979	--	--	34,739	5,291	21,752
Douglas	599,983	12,474	201,158	252,010	--	72,573	49,930	11,838
Jackson and Josephine[1]	392,634	--	169,513	87,159	--	96,812	20,047	19,103
Total	1,349,277	16,869	415,402	393,190	--	353,686	101,530	68,600
Central								
Deschutes, Jefferson, and Lake[1]	76,235	--	30,771	--	5,256	35,894	3,003	1,311
Klamath	111,490	--	47,181	11,521	--	33,168	840	18,780
Total	187,725	--	77,952	11,521	5,256	69,062	3,843	20,091
Blue Mountain								
Baker, Grant, Harney, Morrow, and Union[1]	186,443	--	133,050	4,523	21,251	13,335	2,706	11,578
All Areas	3,305,705	90,657	1,253,934	584,241	36,908	820,574	336,974	182,417

---

[1] Combined to avoid disclosure.

Table 46—Dependency of veneer and plywood mills for logs by ownership origin and resource area, Oregon, 1976

(Number of mills)

Resource area	National Forest				State				Bureau of Land Management				Other public			
	Dependency (percent)															
	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100
Northwest	8	5	4	4	11	8	2	--	13	8	--	--	16	5	--	--
West Central	20	5	15	13	49	3	1	--	27	21	5	--	52	1	--	--
Southwest	20	10	12	2	38	6	--	--	20	14	6	4	44	--	--	--
Central	3	1	2	3	9	--	--	--	7	1	1	--	8	1	--	--
Blue Mountain	--	--	2	3	5	--	--	--	3	2	--	--	4	--	1	--
All Areas	51	21	35	25	112	17	3	--	70	46	12	4	124	7	1	--

Resource area	Forest industry								Farmer and miscellaneous private			
	Own lands				Other industry							
	Dependency (percent)											
	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100
Northwest	12	3	6	--	11	7	--	3	12	9	--	--
West Central	34	7	7	5	36	11	5	1	39	12	1	1
Southwest	25	9	5	5	29	10	5	--	30	13	--	1
Central	6	1	--	2	7	2	--	--	5	3	--	1
Blue Mountain	3	2	--	--	4	1	--	--	--	5	--	--
All Areas	80	22	18	12	87	31	10	4	86	42	1	3

Table 47—Log consumption by veneer and plywood mills by species, resource area, and county, Oregon, 1976

(Thousand board feet, Scribner log rule)

Resource area and county	All species	Douglas-fir	Hemlock	True firs	Spruce	Ponderosa pine	Lodgepole pine	Western redcedar	Other softwoods	Hardwoods
Northwest										
Clackamas and Marion[1]	91,123	73,105	11,584	4,336	--	2,098	--	--	--	--
Clatsop and Columbia[1]	93,337	58,523	16,730	1,950	12,696	--	--	--	3,438	--
Multnomah	35,650	22,965	633	--	11,616	--	160	216	60	--
Polk	109,017	90,139	6,632	874	8,914	--	--	--	1,378	1,080
Tillamook, Washington, and Yamhill[1]	75,490	57,301	2,704	--	13,731		--	--	--	1,754
Total	404,617	302,033	38,283	7,160	46,957	2,098	160	216	4,876	2,834
West Central										
Benton and Lincoln[1]	77,259	73,383	510	--	3,366	--	--	--	--	--
Lane	779,558	735,392	24,732	2,265	1,513	400	11,814	288	3,007	147
Linn	320,826	270,748	38,784	7,900	636	920	--	920	918	--
Total	1,177,643	1,079,523	64,026	10,165	5,515	1,320	11,814	1,208	3,925	147
Southwest										
Coos	264,899	247,571	9,350	--	5,348	412	412	722	1,084	--
Curry	91,761	80,034	1,764	6,584	1,615	1,764	--	--	--	--
Douglas	599,983	544,396	41,967	2,660	--	3,440	--	4,620	2,900	--
Jackson and Josephine[1]	392,634	294,023	2,003	66,864	--	3,850	--	--	25,894	--
Total	1,349,277	1,166,024	55,084	76,108	6,963	9,466	412	5,342	29,878	--
Central										
Deschutes, Jefferson, and Lake[1]	76,235	44,613	735	25,887	735	3,705	560	--	--	--
Klamath	111,490	2,381	3,167	67,736	--	16,891	21,315	--	--	--
Total	187,725	46,994	3,902	93,623	735	20,596	21,875	--	--	--
Blue Mountain										
Baker, Grant, Harney, Morrow, and Umatilla[1]	196,443	100,604	--	52,365	1,082	27,989	--	--	14,393	--
All Areas	3,315,705	2,695,178	161,295	239,421	61,252	61,469	34,261	6,766	53,072	2,981

[1] Combined to avoid disclosure.

Table 48—Log consumption by veneer and plywood mills by species, resource area, and type of material, Oregon, 1976

(Thousand board feet, Scribner log rule)

Resource area and type of material	All species	Douglas-fir	Hemlock	True firs	Spruce	Ponderosa pine	Lodgepole pine	Western redcedar	Other softwoods	Hardwoods
Northwest										
Sound[1]	367,725	270,806	33,919	6,760	46,275	2,098	139	216	4,678	2,834
Utility	36,892	31,227	4,364	400	682	--	21	--	198	--
Total	404,617	302,033	38,283	7,160	46,957	2,098	160	216	4,876	2,834
West Central										
Sound[1]	893,700	807,745	53,145	9,245	5,375	1,320	11,814	1,180	3,876	--
Utility	283,943	271,778	10,881	920	140	--	--	28	49	147
Total	1,177,643	1,079,523	64,026	10,165	5,515	1,320	11,814	1,208	3,925	147
Southwest										
Sound[1]	1,105,540	930,881	51,459	73,036	6,816	7,716	412	5,342	29,878	--
Utility	243,737	235,143	3,625	3,072	147	1,750	--	--	--	--
Total	1,349,277	1,166,024	55,084	76,108	6,963	9,466	412	5,342	29,878	--
Central										
Sound[1]	180,116	45,509	3,821	90,871	735	19,711	19,469	--	--	--
Utility	7,609	1,485	81	2,752	--	885	2,406	--	--	--
Total	187,725	46,994	3,902	93,623	735	20,596	21,875	--	--	--
Blue Mountain										
Sound[1]	186,243	90,514	--	52,275	1,082	27,989	--	--	14,383	--
Utility	200	100	--	90	--	--	--	--	10	--
Total	186,443	90,614	--	52,365	1,082	27,989	--	--	14,393	--
Total State										
Sound[1]	2,733,324	2,145,455	142,344	232,187	60,283	58,834	31,834	6,738	52,815	2,834
Utility	572,381	539,733	18,951	7,234	969	2,635	2,427	28	257	147
Total	3,305,705	2,685,188	161,295	239,421	61,252	61,469	34,261	6,766	53,072	2,981

[1] Includes both live and dead logs.

Table 49—Production and disposition of wood and bark residues by veneer and plywood mills by resource area, and county, Oregon, 1976

(Tons, dry weight)

Resource area and county	All residues			Wood residue			Bark residue		
	Total	Used[1]	Unused	Total	Used[1]	Unused	Total	Used[1]	Unused
Northwest									
Clackamas and Marion[2]	163,158	152,812	10,346	127,177	127,177	--	35,981	25,635	10,346
Clatsop and Columbia[2]	191,076	191,076	--	148,994	148,994	--	42,082	42,082	--
Multnomah	120,963	120,963	--	96,281	96,281	--	24,682	24,682	--
Polk	288,852	281,933	6,919	227,246	220,327	6,919	61,606	61,606	--
Tillamook, Washington, and Yamhill[2]	201,275	143,026	58,249	158,701	127,110	31,591	42,574	15,916	26,658
Total	965,324	889,810	75,514	758,399	719,889	38,510	206,925	169,921	37,004
West Central									
Benton and Lincoln[2]	193,886	193,886	--	155,868	155,868	--	38,018	38,018	--
Lane	1,536,802	1,524,610	12,192	1,185,977	1,179,868	6,109	350,825	344,742	6,083
Linn	694,762	694,762	--	559,303	559,303	--	135,459	135,459	--
Total	2,425,450	2,413,258	12,192	1,901,148	1,895,039	6,109	524,302	518,219	6,083
Southwest									
Coos	437,997	428,374	9,623	348,031	348,031	--	89,966	80,343	9,623
Curry	194,488	190,511	3,977	153,520	153,520	--	40,968	36,991	3,977
Douglas	1,114,740	1,098,251	16,489	895,691	893,290	2,401	219,049	204,961	14,088
Jackson and Josephine[2]	900,896	876,595	24,301	722,143	721,070	1,073	178,753	155,525	23,228
Total	2,648,121	2,593,731	54,390	2,119,385	2,115,911	3,474	528,736	477,820	50,916
Central									
Deschutes, Jefferson, and Lake[2]	156,994	149,563	7,431	123,097	118,558	4,539	33,897	31,005	2,892
Klamath	164,878	150,135	14,743	129,284	126,413	2,871	35,594	23,722	11,872
Total	321,872	299,698	22,174	252,381	244,971	7,410	69,491	54,727	14,764
Blue Mountain									
Baker, Grant, Harney, Morrow, and Union[2]	332,681	308,529	24,152	259,799	248,330	11,469	72,882	60,199	12,683
All Areas	6,693,448	6,505,026	188,422	5,291,112	5,224,140	66,972	1,402,336	1,280,886	121,450

[1] Not necessarily used in the area or county in which produced.

[2] Combined to avoid disclosure.

Table 50--*Production and disposition of wood residue by veneer and plywood mills by type of residue, resource area, and county, Oregon 1976*

(Tons, dry weight)

Resource area and county	All types						
	Total	Total used[3]	Pulp	Board	Fuel	Miscellaneous	Unused
Northwest							
Clackamas and Marion[4]	127,177	127,177	85,441	11,051	11,761	18,924	--
Clatsop and Columbia[4]	148,994	148,994	65,366	7,066	54,371	22,191	--
Multnomah	96,281	96,281	68,688	--	15,793	11,800	--
Polk	227,246	220,327	138,499	2,728	42,188	36,912	6,919
Tillamook, Washington, and Yamhill[4]	158,701	127,110	34,050	47,429	28,508	17,123	31,591
Total	758,399	719,889	392,044	68,274	152,621	106,950	38,510
West Central							
Benton and Lincoln[4]	155,868	155,868	98,223	19,135	19,501	19,009	--
Lane	1,185,977	1,179,868	819,511	77,317	96,407	186,633	6,109
Linn	559,303	559,303	252,591	59,462	101,484	145,766	--
Total	1,901,148	1,895,039	1,170,325	155,914	217,392	351,408	6,109
Southwest							
Coos	348,031	348,031	143,320	35,861	26,379	142,471	--
Curry	153,520	153,520	110,625	--	17,784	25,111	--
Douglas	895,691	893,290	594,020	125,435	31,582	142,253	2,401
Jackson and Josephine[4]	722,143	721,070	445,355	57,111	107,025	111,579	1,073
Total	2,119,385	2,115,911	1,293,320	218,407	182,770	421,414	3,474
Central							
Deschutes, Jefferson, and Lake[4]	123,097	118,558	80,672	24,587	1,859	11,440	4,539
Klamath	129,284	126,413	90,455	2,640	13,052	20,266	2,871
Total	252,381	244,971	171,127	27,227	14,911	31,706	7,410
Blue Mountain							
Baker, Grant, Harney, Morrow, and Union[4]	259,799	248,330	138,810	28,995	68,012	12,513	11,469
All Areas	5,291,112	5,224,140	3,165,626	498,817	635,706	923,991	66,972

See footnotes at end of table.

Table 50--*Production and disposition of wood residue by veneer and plywood mills by type of residue, resource area, and county, Oregon 1976* (continued)

(Tons, dry weight)

Resource area and county	Coarse[1]						
	Total	Total used[3]	Pulp	Board	Fuel	Miscellaneous	Unused
Northwest							
Clackamas and Marion[4]	123,876	123,876	85,441	11,051	9,575	17,809	--
Clatsop and Columbia[4]	144,204	144,204	65,366	7,066	49,581	22,191	--
Multnomah	92,152	92,152	68,688	--	13,842	9,622	--
Polk	219,694	212,775	138,499	2,728	34,636	36,912	6,919
Tillamook, Washington, and Yamhill[4]	153,151	124,374	34,050	47,429	25,772	17,123	28,777
Total	733,077	697,381	392,044	68,274	133,406	103,657	35,696
West Central							
Benton and Lincoln[4]	152,041	152,041	98,223	15,308	19,501	19,009	--
Lane	1,160,417	1,154,308	819,511	75,755	74,151	184,891	6,109
Linn	517,859	517,859	252,591	54,039	67,157	144,072	--
Total	1,830,317	1,824,208	1,170,325	145,102	160,809	347,972	6,109
Southwest							
Coos	335,251	335,251	143,320	35,861	16,158	139,912	--
Curry	148,017	148,017	110,625	--	12,281	25,111	--
Douglas	867,069	864,668	590,500	123,971	11,099	139,098	2,401
Jackson and Josephine[4]	691,247	690,389	445,355	56,275	80,943	107,816	858
Total	2,041,584	2,038,325	1,289,800	216,107	120,481	411,937	3,259
Central							
Deschutes, Jefferson, and Lake[4]	119,329	115,698	80,672	21,727	1,859	11,440	3,631
Klamath	125,331	122,460	90,455	2,640	9,099	20,266	2,871
Total	244,660	238,158	171,127	24,367	10,958	31,706	6,502
Blue Mountain							
Baker, Grant, Harney, Morrow, and Union[4]	252,673	241,204	138,810	28,995	60,886	12,513	11,469
All Areas	5,102,311	5,039,276	3,162,106	482,845	486,540	907,785	63,035

See footnotes at end of table.

Table 50--*Production and disposition of wood residue by veneer and plywood mills by type of residue, resource area, and county, Oregon 1976* (continued)

(Tons, dry weight)

Resource area and county	Fine[2]						
	Total	Total used[3]	Pulp	Board	Fuel	Miscellaneous	Unused
Northwest							
Clackamas and Marion[4]	3,301	3,301	--	--	2,186	1,115	--
Clatsop and Columbia[4]	4,790	4,790	--	--	4,790	--	--
Multnomah	4,129	4,129	--	--	1,951	2,178	--
Polk	7,552	7,552	--	--	7,552	--	--
Tillamook, Washington, and Yamhill[4]	5,550	2,736	--	--	2,736	--	2,814
Total	25,322	22,508	--	--	19,215	3,293	2,814
West Central							
Benton and Lincoln[4]	3,827	3,827	--	3,827	--	--	--
Lane	25,560	25,560	--	1,562	22,256	1,742	--
Linn	41,444	41,444	--	5,423	34,327	1,694	--
Total	70,831	70,831	--	10,812	56,583	3,436	--
Southwest							
Coos	12,780	12,780	--	--	10,221	2,559	--
Curry	5,503	5,503	--	--	5,503	--	--
Douglas	28,622	28,622	3,520	1,464	20,483	3,155	--
Jackson and Josephine[4]	30,896	30,681	--	836	26,082	3,763	215
Total	77,801	77,586	3,520	2,300	62,289	9,477	215
Central							
Deschutes, Jefferson, and Lake[4]	3,768	2,860	--	2,860	--	--	908
Klamath	3,953	3,953	--	--	3,953	--	--
Total	7,721	6,813	--	2,860	3,953	--	908
Blue Mountain							
Baker, Grant, Harney, Morrow, and Union[4]	7,126	7,126	--	--	7,126	--	--
All Areas	188,801	184,864	3,520	15,972	149,166	16,206	3,937

[1] Coarse residue includes log trim, cores, veneer clippings, rejected veneer, roundup, spur trim.

[2] Fine residue includes sawdust and sander dust.

[3] Not necessarily used in the area or county in which produced.

[4] Combined to avoid disclosure.

Table 51--*Production and disposition of bark residue by veneer and plywood mills by use, resource area, and county, Oregon, 1976*

(Tons, dry weight)

Resource area and county	All bark	Total used	Used[1]				Unused
			Pulp	Board	Fuel	Miscellaneous	
Northwest							
Clackamas and Marion[2]	35,981	25,635	--	--	7,788	17,847	10,346
Clatsop and Columbia[2]	42,082	42,082	--	--	42,082	--	--
Multnomah	24,682	24,682	--	--	315	24,367	--
Polk	61,606	61,606	--	--	61,606	--	--
Tillamook, Washington, and Yamhill[2]	42,574	15,916	--	--	15,916	--	26,658
Total	206,925	169,921	--	--	127,707	42,214	37,004
West Central							
Benton and Lincoln[2]	38,018	38,018	--	--	38,018	--	--
Lane	350,825	344,742	--	8,675	279,075	56,992	6,083
Linn	135,459	135,459	--	--	132,159	3,300	--
Total	524,302	518,219	--	8,675	449,252	60,292	6,083
Southwest							
Coos	89,966	80,343	--	--	78,746	1,597	9,623
Curry	40,968	36,991	--	--	23,858	13,133	3,977
Douglas	219,049	204,961	--	--	183,102	21,859	14,088
Jackson and Josephine[2]	178,753	155,525	--	--	128,465	27,060	23,228
Total	528,736	477,820	--	--	414,171	63,649	50,916
Central							
Deschutes, Jefferson, and Lake[2]	33,897	31,005	--	--	31,005	--	2,892
Klamath	35,594	23,722	--	--	18,262	5,460	11,872
Total	69,491	54,727	--	--	49,267	5,460	14,764
Blue Mountain							
Baker, Grant, Harney, Morrow, and Union[2]	72,882	60,199	--	--	60,199	--	12,683
All Areas	1,402,336	1,280,886	--	8,675	1,100,596	171,615	121,450

---

[1] Not necessarily used in the area or county in which produced.

[2] Combined to avoid disclosure.

Table 52--*Number of pulpmills and board mills by type of operation, resource area, and county, Oregon, 1976*

Resource area and county	All mills	Type of pulpmill				Type of board mill		
		Sulfite	Sulfate	Groundwood	Semichemical	Hardboard	Particleboard	Insulation board
Northwest								
Clackamas	3	1	--	2	--	--	--	--
Clatsop	2	--	1	1	--	--	--	--
Columbia	2	--	1	--	--	--	--	1
Hood River	1	--	--	--	--	1	--	--
Marion	1	1	--	--	--	--	--	--
Washington	1	--	--	--	--	1	--	--
Yamhill	2	1	--	1	--	--	--	--
Total	12	3	2	4	--	2	--	1
West Central								
Benton	2	--	--	--	--	1	1	--
Lane	4	--	1	--	--	1	2	--
Lincoln	1	--	1	--	--	--	--	--
Linn	7	1	3	--	--	1	2	--
Total	14	1	5	--	--	3	5	--
Southwest								
Coos	2	1	--	--	--	1	--	--
Douglas	3	--	1	--	--	--	2	--
Jackson	2	--	--	--	--	--	2	--
Total	7	1	1	--	--	1	4	--
Central								
Deschutes	1	--	--	--	--	--	1	--
Klamath	3	--	--	--	--	1	2	--
Total	4	--	--	--	--	1	3	--
Blue Mountain								
Umatilla	2	--	--	--	--	1	--	1
Union	1	--	--	--	--	--	1	--
Total	3	--	--	--	--	1	1	1
All Areas	40	5	8	4	--	8	13	2

Table 53--*Installed capacity of pulpmills and board mills by type of mill, resource area, and county, Oregon, 1976*

Resource area and county	Type of pulpmill				Type of board mill		
	Sulfite	Sulfate	Groundwood	Semichemical	Hardboard	Particleboard	Insulation board
	- - - 24 hrs., tons - - -				- - - Annual - - -		
					MM sq ft 1/8-inch basis	MM sq ft 3/4-inch basis	MM sq ft 1/2-inch basis
Northwest							
Clackamas	174	--	877	--	--	--	--
Clatsop	--	825	293	--	--	--	--
Columbia	--	730	--	--	--	--	150
Hood River	--	--	--	--	100	--	--
Marion	248	--	--	--	--	--	--
Washington	--	--	--	--	120	--	--
Yamhill	250	--	330	--	--	--	--
Total	672	1,555	1,500	--	220	--	150
West Central							
Benton	--	--	--	--	115	17	--
Lane	--	1,200	--	--	1,388	175	--
Lincoln	--	1,240	--	--	--	--	--
Linn	100	1,050	--	--	106	195	--
Total	100	3,490	--	--	1,609	387	--
Southwest							
Coos	323	--	--	--	262	--	--
Douglas	--	568	--	--	--	695	--
Jackson	--	--	--	--	--	150	--
Total	323	568	--	--	262	845	--
Central							
Deschutes	--	--	--	--	--	148	--
Klamath	--	--	--	--	200	102	--
Total	--	--	--	--	200	250	--
Blue Mountain							
Umatilla	--	--	--	--	78	--	80
Union	--	--	--	--	--	149	--
Total	--	--	--	--	78	149	80
All Areas	1,095	5,613	1,500	--	2,369	1,631	230

Table 54--*Number of pulpmills and board mills by years of tenure of present ownership, type of mill, and years at site, Oregon, 1976*

Mill type and years at site	Tenure of present ownership (years)				
	0-2	3-5	6-10	11-20	21+
Sulfite					
11-20	--	--	--	1	--
21+	--	--	--	2	2
Sulfate					
6-10	--	--	2	--	--
11-20	--	--	--	3	--
21+	--	--	--	1	2
Groundwood					
11-20	--	--	--	1	--
21+	--	--	--	1	2
Hardboard					
11-20	--	--	--	2	--
21+	--	--	--	3	3
Particleboard					
0- 2	2	--	--	--	--
3- 5	1	1	--	--	--
11-20	1	--	2	6	--
Insulation board					
21+	--	--	--	1	1
Total	4	1	4	21	10

Table 55--*Average number of operating days of pulpmills and board mills by resource area, Oregon, 1976*

Resource area	Pulp	Board
Northwest	334	297
West Central	346	280
Southwest	271	240
Central	--	275
Blue Mountain	--	340
All Areas	331	280

Table 56—Wood consumption[1] by pulpmills and board mills by type of material consumed and resource area, Oregon, 1976

Resource area	Roundwood			Other					
					Chips				
	Total	Sound logs	Utility logs	Total	From mill residue	From roundwood chipping mill	Sawdust	Shavings	Bark
	- - - - - Thousand board feet Scribner log rule - - - - -			- - - - - Tons, dry weight - - - - -					
Northwest	56,000	15,000	41,000	1,801,241	1,447,718	39,580	266,896	47,047	--
West Central	--	--	--	3,085,234	1,760,790	559,725	273,463	491,256	--
Southwest	15,000	15,000	--	1,725,994	562,628	39,914	167,432	956,020	--
Central and Blue Mountain[2]	--	--	--	684,029	77,036	32,500	25,208	549,285	--
Total, State	71,000	30,000	41,000	7,296,498	3,848,172	671,719	732,999	2,043,608	--

---

[1] See page 1 of text for discussion of other material consumed.

[2] Combined to avoid disclosure.

Table 57--*Log consumption by pulpmills and board mills, by timber age group and resource area, Oregon, 1976*

(Thousand board feet, Scribner log rule)

Resource area	All age groups	Old growth (100+ years)	Young growth (less than 100 years)
Northwest	56,000	7,200	48,800
Southwest	15,000	--	15,000
All Areas	71,000	7,200	63,800

Table 58--*Log consumption by pulpmills and board mills by ownership class, and resource area, Oregon, 1976*

(Thousand board feet, Scribner log rule)

Resource area	All owners	State	National Forest	Bureau of Land Management	Other public	Forest industry		Farmer and miscellaneous private
						Own lands	Other industry	
Northwest	56,000	640	--	640	1,200	48,240	1,920	3,360
Southwest	15,000	--	600	450	--	300	13,350	300
All Areas	71,000	640	600	1,090	1,200	48,540	15,270	3,660

Table 59—Dependency of pulpmills and board mills for logs by ownership origin and resource area, Oregon, 1976

(Number of mills)

Resource area	National Forest				State				Bureau of Land Management				Other public			
	Dependency (percent)															
	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100
Northwest	12	--	--	--	10	2	--	--	10	2	--	--	11	1	--	--
Southwest	6	1	--	--	7	--	--	--	6	1	--	--	7	--	--	--
All Areas	18	1	--	--	17	2	--	--	16	3	--	--	18	1	--	--

Resource area	Forest industry								Farmer and miscellaneous private			
	Own lands				Other industry							
	Dependency (percent)											
	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100
Northwest	9	--	--	3	10	2	--	--	9	3	--	--
Southwest	6	1	--	--	6	--	--	1	6	1	--	--
All Areas	15	1	--	3	16	2	--	1	15	4	--	--

Table 60--*Log consumption by pulpmills and board mills by species, resource area, and type of material, Oregon, 1976*

(Thousand board feet, Scribner log rule)

Resource area and type of material	All species	Douglas-fir	Hemlock	True firs	Spruce	Other softwoods	Hardwoods
Northwest							
Sound[1]	15,000	6,000	9,000	--	--	--	--
Utility	41,000	7,450	30,940	580	580	--	1,450
Total	56,000	13,450	39,940	580	580	--	1,450
Southwest							
Sound[1]	15,000	--	--	--	--	--	15,000
Utility	--	--	--	--	--	--	--
Total	15,000	--	--	--	--	--	15,000
All Areas							
Sound[1]	30,000	6,000	9,000	--	--	--	15,000
Utility	41,000	7,450	30,940	580	580	--	1,450
Total	71,000	13,450	39,940	580	580	--	16,450

[1] Includes both live and dead logs.

Table 61--*Pulpmill and board mill consumption of mill residues and chips from other sources, by State, resource area, and type of material, Oregon, 1976*

(Tons, dry weight)

Resource area and type of material	Total volume	Oregon	Washington	California	Idaho	Other
Northwest						
Chip residue	1,447,718	1,063,945	221,487	8,637	110,771	42,878
Chips; other sources	39,580	38,417	319	844	--	--
Sawdust and shavings	313,943	260,297	53,646	--	--	--
Total	1,801,241	1,362,659	275,452	9,481	110,771	42,878
West Central						
Chip residue	1,760,790	1,752,297	--	--	8,493	--
Chips; other sources	559,725	559,725	--	--	--	--
Sawdust and shavings	764,719	764,719	--	--	--	--
Total	3,085,234	3,076,741	--	--	8,493	--
Southwest						
Chip residue	562,628	525,411	--	37,217	--	--
Chips; other sources	39,914	39,116	--	798	--	--
Sawdust and shavings	1,123,452	1,097,011	--	26,441	--	--
Total	1,725,994	1,661,538	--	64,456	--	--
Central and Blue Mountain[1]						
Chip residue	77,036	77,036	--	--	--	--
Chips; other sources	32,500	32,500	--	--	--	--
Sawdust and shavings	574,493	477,283	39,175	2,365	55,670	--
Total	684,029	586,819	39,175	2,365	55,670	--
All Areas						
Chip residue	3,848,172	3,418,689	221,487	45,854	119,264	42,878
Chips; other sources	671,719	669,758	319	1,642	--	--
Sawdust and shavings	2,776,607	2,599,310	92,821	28,806	55,670	--
Total	7,296,498	6,687,757	314,627	76,302	174,934	42,878

[1] Combined to avoid disclosure.

Table 62--*Number of "other industry" mills by type of industry, resource area, and county, Oregon, 1976*

(Number of mills)

Resource area and county	All types	Shake and shingle	Export	Post, pole, and piling
Northwest				
Clackamas	1	1	--	--
Clatsop	10	1	9	--
Columbia	3	2	--	1
Multnomah	10	1	7	2
Polk	2	2	--	--
Tillamook	8	8	--	--
Washington	1	--	--	1
Total	35	15	16	4
West Central				
Benton	1	1	--	--
Lane	18	15	--	3
Lincoln	7	4	3	--
Linn	7	6	--	1
Total	33	26	3	4
Southwest				
Coos	10	1	9	--
Curry	1	1	--	--
Douglas	2	2	--	--
Total	13	4	9	--
Central				
Wasco	1	--	--	1
Blue Mountain				
Umatilla	1	1	--	--
All Areas	83	46	28	9

Table 63--*Installed capacity of "other industry" mills by resource area and county, Oregon, 1976*

Resource area and county	Shake and shingle (8-hour shift)	Post, pole, and piling (yearly)
	Squares	Thousand board feet Scribner log rule
Northwest		
Clackamas	105	--
Clatsop	30	--
Columbia	206	21,200
Multnomah	64	7,820
Polk	150	--
Tillamook	339	--
Washington	--	3,850
Total	894	32,870
West Central		
Benton	32	--
Lane	1,080	13,783
Lincoln	357	--
Linn	479	3,280
Total	1,948	17,063
Southwest		
Coos	25	--
Curry	20	--
Douglas	114	--
Total	159	--
Central		
Wasco	--	710
Blue Mountain		
Umatilla	35	--
All Areas	3,036	50,643

Table 64--*Number of shake and shingle mills with selected equipment by resource area and county, Oregon, 1976*

Resource area and county	Chipper	Barker	Burner
Northwest			
Clackamas	--	--	1
Clatsop	--	--	1
Columbia	--	--	1
Multnomah	1	--	--
Polk	1	--	--
Tillamook	1	--	3
Total	3	--	6
West Central			
Benton	--	--	--
Lane	4	1	--
Lincoln	1	--	1
Linn	3	--	--
Total	8	1	1
Southwest			
Coos	--	--	--
Curry	--	--	--
Douglas	1	--	1
Total	1	--	1
Blue Mountain			
Umatilla	--	--	1
All Areas	12	1	9

Table 65--*Number of "other industry" mills by years of tenure of present ownership, type of mill, and years at site, Oregon, 1976*

Type of mill and years at site	All mills	Tenure of present mill ownership (years)				
		0-2	3-5	6-10	11-20	21+
Shake and shingle						
0- 2	2	2	--	--	--	--
3- 5	6	1	5	--	--	--
6-10	16	2	2	12	--	--
11-20	9	--	1	2	6	--
21+	13	3	--	1	1	8
Total	46	8	8	15	7	8
Post, pole, and piling						
6-10	1	1	--	--	--	--
11-20	3	--	--	2	1	--
21+	5	--	--	--	--	5
Total	9	1	--	2	1	5

Table 66--*Average number of operating days per year of "other industry" mills by type of mill and resource area, Oregon, 1976*

Resource area	Shake and shingle	Post, pole, and piling
Northwest	194	187
West Central[1]	193	155
Southwest[2]	218	--
Central[1]	--	--
Blue Mountain[2]	--	--
All Areas	196	169

[1] West Central and Central post, pole, and piling combined to avoid disclosure.

[2] Southwest and Blue Mountain shake and shingle combined to avoid disclosure.

Table 67--*Wood consumption by "other industry" mills by type of material, resource area, and type of mill, Oregon, 1976*

(Thousand board feet, Scribner log rule)

Resource area and type of mill	All types	Sound logs	Utility logs	Other
Northwest				
Shake and shingle	12,923	4,228	2,325	6,370
Export	338,690	338,690	--	--
Post, pole, and piling	19,345	18,607	738	--
Total	370,958	361,525	3,063	6,370
West Central				
Shake and shingle	29,810	21,517	5,297	2,996
Export	20,920	20,920	--	--
Post, pole, and piling[1]	6,328	6,328	--	--
Total	57,058	48,765	5,297	2,996
Southwest				
Shake and shingle[2]	4,559	2,489	1,460	610
Export	134,944	134,694	250	--
Total	139,503	137,183	1,710	610
Central				
Post, pole, and piling[1]	--	--	--	--
Blue Mountain				
Shake and shingle[2]	--	--	--	--
All Areas				
Shake and shingle	47,292	28,234	9,082	9,976
Export	494,554	494,304	250	--
Post, pole, and piling	25,673	24,935	738	--
Total	567,519	547,473	10,070	9,976

[1] West Central and Central combined to avoid disclosure.

[2] Southwest and Blue Mountain combined to avoid disclosure.

Table 68--*Log consumption by "other industry" mills by timber age group, resource area and type of mill, Oregon, 1976*

(Thousand board feet, Scribner log rule)

Resource area and type of mill	All age groups	Old growth (100+ years)	Young growth (less than 100 years)
Northwest			
Shake and shingle	6,553	6,387	166
Export	338,690	168,961	169,729
Post, pole, and piling	19,345	2,780	16,565
Total	364,588	178,128	186,460
West Central			
Shake and shingle	26,814	21,165	5,649
Export	20,920	2,410	18,510
Post, pole, and piling[1]	6,328	256	6,072
Total	54,062	23,831	30,231
Southwest			
Shake and shingle[2]	3,949	3,247	702
Export	134,944	102,371	32,573
Total	138,893	105,618	33,275
Central			
Post, pole, and piling[1]	--	--	--
Blue Mountain			
Shake and shingle[2]	--	--	--
All Areas			
Shake and shingle	37,316	30,799	6,517
Export	494,554	273,742	220,812
Post, pole, and piling	25,673	3,036	22,637
Total	557,543	307,577	249,966

[1] West Central and Central combined to avoid disclosure.

[2] Southwest and Blue Mountain combined to avoid disclosure.

Table 69—Log consumption by "other industry" mills by ownership class, resource area, and type of mill, Oregon, 1976

(Thousand board feet, Scribner log rule)

Resource area and type of mill	All owners	State	National Forest	Bureau of Land Management	Other public	Forest industry		Farmer and miscellaneous private
						Own wood supply	Other wood supply	
Northwest								
Shake and shingle	6,553	151	1,286	505	--	413	4,141	57
Export	338,690	26,588	9,808	--	5,093	9,000	179,476	108,725
Post, pole, and piling	19,345	545	1,310	--	--	--	4,865	12,625
Total	364,588	27,284	12,404	505	5,093	9,413	188,482	121,407
West Central								
Shake and shingle	26,814	296	4,814	1,883	22	--	12,416	7,383
Export	20,920	--	400	500	--	--	19,620	400
Post, pole, and piling[1]	6,328	95	707	230	--	1,605	986	2,705
Total	54,062	391	5,921	2,613	22	1,605	33,022	10,488
Southwest								
Shake and shingle[2]	3,949	--	1,210	40	--	--	2,354	345
Export	134,944	--	28,860	1,147	--	6,912	88,457	9,568
Total	138,893	--	30,070	1,187	--	6,912	90,811	9,913
Central								
Post, pole, and piling[1]	--	--	--	--	--	--	--	--
Blue Mountain								
Shake and shingle[2]	--	--	--	--	--	--	--	--
All Areas								
Shake and shingle	37,316	447	7,310	2,428	22	413	18,911	7,785
Export	494,554	26,588	39,068	1,647	5,093	15,912	287,553	118,693
Post, pole, and piling	25,673	640	2,017	230	--	1,605	5,851	15,330
Total	557,543	27,675	48,395	4,305	5,115	17,930	312,315	141,808

---

[1] West Central and Central combined to avoid disclosure.

[2] Southwest and Blue Mountain combined to avoid disclosure.

Table 70—Dependency of "other industry" mills for logs by ownership origin, resource area, and type of mill, Oregon, 1976

(Number of mills)

Resource area	National Forest				State				Bureau of Land Management				Other public			
	Dependency (percent)															
	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100
Northwest																
Shake and shingle	11	2	--	2	12	2	1	--	11	3	--	1	15	--	--	--
Export	12	4	--	--	10	4	2	--	16	--	--	--	15	--	1	--
Post, pole, and piling	1	2	--	1	3	1	--	--	4	--	--	--	4	--	--	--
Total	24	8	--	3	25	7	3	--	31	3	--	1	34	--	1	--
West Central																
Shake and shingle	18	4	3	1	24	2	--	--	21	4	1	--	25	--	--	1
Export	2	1	--	--	3	--	--	--	2	1	--	--	3	--	--	--
Post, pole, and piling	1	2	--	1	3	1	--	--	2	2	--	--	4	--	--	--
Total	21	7	3	2	30	3	--	--	25	7	1	--	32	--	--	1
Southwest																
Shake and shingle	3	1	--	--	4	--	--	--	3	--	--	1	4	--	--	--
Export	3	3	2	1	9	--	--	--	7	2	--	--	9	--	--	--
Total	6	4	2	1	13	--	--	--	10	2	--	1	13	--	--	--
Central																
Post, pole, and piling	--	1	--	--	--	1	--	--	1	--	--	--	1	--	--	--
Blue Mountain																
Shake and shingle	--	--	--	1	1	--	--	--	1	--	--	--	1	--	--	--
All Areas																
Shake and shingle	32	7	3	4	41	4	1	--	36	7	1	2	45	--	--	1
Export	17	8	2	1	22	4	2	--	25	3	--	--	27	--	1	--
Post, pole, and piling	2	5	--	2	6	3	--	--	7	2	--	--	9	--	--	--
Total	51	20	5	7	69	11	3	--	68	12	1	2	81	--	1	1

Table 70—Dependency of "other industry" mills for logs by ownership origin, resource area, and type of mill, Oregon, 1976—Continued

(Number of mills)

Resource area	Forest industry								Farmer and miscellaneous private			
	Own lands				Other industry							
	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100
Northwest												
Shake and shingle	13	--	--	2	11	1	--	3	13	2	--	--
Export	15	--	1	--	3	--	2	11	10	5	--	1
Post, pole, and piling	4	--	--	--	3	--	--	1	1	1	--	2
Total	32	--	1	2	17	1	2	15	24	8	--	3
West Central												
Shake and shingle	26	--	--	--	14	1	4	7	17	6	1	2
Export	3	--	--	--	--	--	1	2	2	1	--	--
Post, pole, and piling	2	1	1	--	1	2	1	--	1	1	1	1
Total	31	1	1	--	15	3	6	9	20	8	2	3
Southwest												
Shake and shingle	4	--	--	--	2	1	--	1	3	--	--	1
Export	8	--	1	--	2	--	2	5	7	2	--	--
Total	12	--	1	--	4	1	2	6	10	2	--	1
Central												
Post, pole, and piling	--	1	--	--	--	1	--	--	--	1	--	--
Blue Mountain												
Shake and shingle	1	--	--	--	1	--	--	--	1	--	--	--
All Areas												
Shake and shingle	44	--	--	2	28	3	4	11	34	8	1	3
Export	26	--	2	--	5	--	5	18	19	8	--	1
Post, pole, and piling	6	2	1	--	4	3	1	1	2	3	1	3
Total	76	2	3	2	37	6	10	30	55	19	2	7

Table 71—Log consumption by "other industry" mills by species, type of mill, and type of material, Oregon, 1976

(Thousand board feet, Scribner log rule)

Industry and type of material	All species	Douglas-fir	Hemlock	True firs	Spruce	Ponderosa pine	Lodgepole pine	Western redcedar	Other softwoods	Hardwoods
Shake and shingle										
Sound[1]	28,234	--	--	--	--	--	--	28,234	--	--
Utility	9,082	--	--	--	--	--	--	7,882	1,200	--
Total	37,316	--	--	--	--	--	--	36,116	1,200	--
Export										
Sound[1]	494,304	188,035	221,970	9,708	33,140	1,673	255	4,513	34,552	458
Utility	250	--	--	--	--	--	--	--	250	--
Total	494,554	188,035	221,970	9,708	33,140	1,673	255	4,513	34,802	458
Post, pole, and piling										
Sound[1]	24,935	23,643	625	--	--	35	18	614	--	--
Utility	738	647	70	--	--	--	21	--	--	--
Total	25,673	24,290	695	--	--	35	39	614	--	--
All Mills										
Sound[1]	547,473	211,678	222,595	9,708	33,140	1,708	273	33,361	34,552	458
Utility	10,070	647	70	--	--	--	21	7,882	1,450	--
Total	557,543	212,325	222,665	9,708	33,140	1,708	294	41,243	36,002	458

---

[1] Includes both live and dead logs.

Table 72—Log consumption by "other industry" mills by species, resource area, and type of mill, Oregon, 1976

(Thousand board feet, Scribner log rule)

Resource area and type of mill	All species	Douglas-fir	Hemlock	True firs	Spruce	Ponderosa pine	Lodgepole pine	Western redcedar	Other softwoods	Hardwoods
Northwest										
Shake and shingle	6,553	--	--	--	--	--	--	6,553	--	--
Export	338,690	103,727	191,255	7,244	28,778	1,363	255	3,755	1,855	458
Post, pole, and piling	19,345	18,066	695	--	--	--	39	545	--	--
Total	364,588	121,793	191,950	7,244	28,778	1,363	294	10,853	1,855	458
West Central										
Shake and shingle	26,814	--	--	--	--	--	--	26,814	--	--
Export	20,920	9,151	10,187	300	1,282	--	--	--	--	--
Post, pole, and piling[1/]	6,328	6,224	--	--	--	35	--	69	--	--
Total	54,062	15,375	10,187	300	1,282	35	--	26,883	--	--
Southwest										
Shake and shingle[2/]	3,949	--	--	--	--	--	--	2,749	1,200	--
Export	134,944	75,157	20,528	2,164	3,080	310	--	758	32,947	--
Total	138,893	75,157	20,528	2,164	3,080	310	--	3,507	34,147	--
Central										
Post, pole, and piling[1/]	--	--	--	--	--	--	--	--	--	--
Blue Mountain										
Shake and shingle[2/]	--	--	--	--	--	--	--	--	--	--
All Areas										
Shake and shingle	37,316	--	--	--	--	--	--	36,116	1,200	--
Export	494,554	188,035	221,970	9,708	33,140	1,673	255	4,513	34,802	458
Post, pole, and piling	25,673	24,290	695	--	--	35	39	614	--	--
Total	557,543	212,325	222,665	9,708	33,140	1,708	294	41,243	36,002	458

[1/] West Central and Central combined to avoid disclosure.

[2/] Southwest and Blue Mountain combined to avoid disclosure.

Table 73—Sound log consumption by "other industry" mills by species, resource area, and type of mill, Oregon, 1976

(Thousand board feet, Scribner log rule)

Resource area and type of mill	All species	Douglas-fir	Hemlock	True firs	Spruce	Ponderosa pine	Lodgepole pine	Western redcedar	Other softwoods	Hardwoods
Northwest										
Shake and shingle	4,228	--	--	--	--	--	--	4,228	--	--
Export	338,690	103,727	191,255	7,244	28,778	1,363	255	3,755	1,855	458
Post, pole, and piling	18,607	17,419	625	--	--	--	18	545	--	--
Total	361,525	121,146	191,880	7,244	28,778	1,363	273	8,528	1,855	458
West Central										
Shake and shingle	21,517	--	--	--	--	--	--	21,517	--	--
Export	20,920	9,151	10,187	300	1,282	--	--	--	--	--
Post, pole, and piling	6,328	6,224	--	--	--	35	--	69	--	--
Total	48,765	15,375	10,187	300	1,282	35	--	21,586	--	--
Southwest										
Shake and shingle[2]	2,489	--	--	--	--	--	--	2,489	--	--
Export	134,694	75,157	20,528	2,164	3,080	310	--	758	32,697	--
Total	137,183	75,157	20,528	2,164	3,080	310	--	3,247	32,697	--
Central										
Post, pole, and piling[1]	--	--	--	--	--	--	--	--	--	--
Blue Mountain										
Shake and shingle[2]	--	--	--	--	--	--	--	--	--	--
All Areas										
Shake and shingle	28,234	--	--	--	--	--	--	28,234	--	--
Export	494,304	188,035	221,970	9,708	33,140	1,673	255	4,513	34,562	458
Post, pole, and piling	24,935	23,643	625	--	--	35	18	614	--	--
Total	547,473	211,678	222,595	9,708	33,140	1,708	273	33,361	34,552	458

---

[1] West Central and Central combined to avoid disclosure.

[2] Southwest and Blue Mountain combined to avoid disclosure.

Table 74—Utility log consumption by "other industry" mills by species, resource area, and type of mill, Oregon, 1976

(Thousand board feet, Scribner log rule)

Resource area and type of mill	All species	Douglas-fir	Hemlock	True firs	Spruce	Ponderosa pine	Lodgepole pine	Western redcedar	Other softwoods	Hardwoods
Northwest										
Shake and shingle	2,325	--	--	--	--	--	--	2,325	--	--
Export	--	--	--	--	--	--	--	--	--	--
Post, pole, and piling	738	647	70	--	--	--	21	--	--	--
Total	3,063	647	70	--	--	--	21	2,325	--	--
West Central										
Shake and shingle	5,297	--	--	--	--	--	--	5,297	--	--
Export	--	--	--	--	--	--	--	--	--	--
Post, pole, and piling	--	--	--	--	--	--	--	--	--	--
Total	5,297	--	--	--	--	--	--	5,297	--	--
Southwest										
Shake and shingle[2]	1,460	--	--	--	--	--	--	260	1,200	--
Export	250	--	--	--	--	--	--	--	250	--
Total	1,710	--	--	--	--	--	--	260	1,450	--
Central										
Post, pole, and piling[1]	--	--	--	--	--	--	--	--	--	--
Blue Mountain										
Shake and shingle[2]	--	--	--	--	--	--	--	--	--	--
All Areas										
Shake and shingle	9,082	--	--	--	--	--	--	7,882	1,200	--
Export	250	--	--	--	--	--	--	--	250	--
Post, pole, and piling	738	647	70	--	--	--	21	--	--	--
Total	10,070	647	70	--	--	--	21	7,882	1,450	--

---

[1] West Central and Central combined to avoid disclosure.

[2] Southwest and Blue Mountain combined to avoid disclosure.

Table 75--*Production and disposition of wood and bark residues by shake and shingle mills by resource area, Oregon, 1976*

(Tons, dry weight)

Resource area	All residues			Wood residue			Bark residue		
	Total	Used[1/]	Unused	Total	Used[1/]	Unused	Total	Used[1/]	Unused
Northwest	11,336	3,403	7,933	8,427	2,854	5,573	2,909	549	2,360
West Central	29,841	19,019	10,822	21,099	14,153	6,946	8,742	4,866	3,876
Southwest and Blue Mountain[2/]	3,707	3,123	584	2,757	2,405	352	950	718	232
All Areas	44,884	25,545	19,339	32,283	19,412	12,871	12,601	6,133	6,468

[1/] Not necessarily used in the resource area in which they were produced.

[2/] Combined to avoid disclosure.

Table 76—Production and disposition of wood residues by shake and shingle mills by type of residue, use, and resource area, Oregon, 1976

(Tons, dry weight)

Resource area	All types						
	Total	Total used[3]	Pulp	Board	Fuel	Miscellaneous	Unused
Northwest	8,427	2,854	--	--	502	2,352	5,573
West Central	21,099	14,153	3,178	--	6,846	4,129	6,946
Southwest and Blue Mountain[4]	2,757	2,405	--	--	2,163	242	352
All Areas	32,283	19,412	3,178	--	9,511	6,723	12,871

Resource area	Coarse[1]						
	Total	Total used[3]	Pulp	Board	Fuel	Miscellaneous	Unused
Northwest	2,526	906	--	--	175	731	1,620
West Central	6,895	5,100	2,847	--	1,955	298	1,795
Southwest and Blue Mountain[4]	748	615	--	--	491	124	133
All Areas	10,169	6,621	2,847	--	2,621	1,153	3,548

Resource area	Fine[2]						
	Total	Total used[3]	Pulp	Board	Fuel	Miscellaneous	Unused
Northwest	5,901	1,948	--	--	327	1,621	3,953
West Central	14,204	9,053	331	--	4,891	3,831	5,151
Southwest and Blue Mountain[4]	2,009	1,790	--	--	1,672	118	219
All Areas	22,114	12,791	331	--	6,890	5,570	9,323

---

[1] End block trim, spalts.

[2] Splints and sawdust.

[3] Not necessarily used in the resource area in which they were produced.

[4] Combined to avoid disclosure.

Table 77--*Production and disposition of bark residues by shake and shingle mills by use and resource area, Oregon, 1976*

(Tons, dry weight)

Resource area	Bark					
	Total	Total used[1]	Pulp and board	Fuel	Miscellaneous	Unused
Northwest	2,909	549	--	130	419	2,360
West Central	8,742	4,866	385	4,069	412	3,876
Southwest and Blue Mountain[2]	950	718	--	624	94	232
All Areas	12,601	6,133	385	4,823	925	6,468

[1] Not necessarily used in the resource area in which they were produced.

[2] Combined to avoid disclosure.

Table 78--*Product output by "other industries" by type of mill and resource area, Oregon, 1976*

Resource area	Shake and shingle	Shipments		
		Export	Post, pole, and piling	
			Treated	Untreated
	Squares	Thousand board feet, Scribner log rule		
Northwest	635,266	338,690	1,843	30,700
West Central	328,942	20,920	6,288	2,305
Southwest	35,640	134,694	--	--
Central	--	--	[1]	[1]
Blue Mountain	[2]	--	--	--
All Areas	999,848	494,304	8,131	33,005

[1] Combined with West Central to avoid disclosure.

[2] Combined with Southwest to avoid disclosure.

GPO 986-675

Howard, James O., and Bruce A. Hiserote.
1978. Oregon's forest products industry, 1976. USDA
For. Serv. Resour. Bull. PNW-79, 102 p., illus.
Pacific Northwest Forest and Range Experiment
Station, Portland, Oregon.

This report presents the findings of a 100-percent canvas of the primary forest products industry in Oregon for 1976. Tabular presentation includes characteristics of the industry log consumption and disposition of mill residues. Accompanying the tables is a descriptive analysis of conditions and trends in the industry.

KEYWORDS: Forest products industry, wood utilization, wood waste utilization, mill operations/products, Oregon.

Howard, James O., and Bruce A. Hiserote.
1978. Oregon's forest products industry, 1976. USDA
For. Serv. Resour. Bull. PNW-79, 102 p., illus.
Pacific Northwest Forest and Range Experiment
Station, Portland, Oregon.

This report presents the findings of a 100-percent canvas of the primary forest products industry in Oregon for 1976. Tabular presentation includes characteristics of the industry log consumption and disposition of mill residues. Accompanying the tables is a descriptive analysis of conditions and trends in the industry.

KEYWORDS: Forest products industry, wood utilization, wood waste utilization, mill operations/products, Oregon.

Howard, James O., and Bruce A. Hiserote.
1978. Oregon's forest products industry, 1976. USDA
For. Serv. Resour. Bull. PNW-79, 102 p., illus.
Pacific Northwest Forest and Range Experiment
Station, Portland, Oregon.

This report presents the findings of a 100-percent canvas of the primary forest products industry in Oregon for 1976. Tabular presentation includes characteristics of the industry log consumption and disposition of mill residues. Accompanying the tables is a descriptive analysis of conditions and trends in the industry.

KEYWORDS: Forest products industry, wood utilization, wood waste utilization, mill operations/products, Oregon.

Howard, James O., and Bruce A. Hiserote.
1978. Oregon's forest products industry, 1976. USDA
For. Serv. Resour. Bull. PNW-79, 102 p., illus.
Pacific Northwest Forest and Range Experiment
Station, Portland, Oregon.

This report presents the findings of a 100-percent canvas of the primary forest products industry in Oregon for 1976. Tabular presentation includes characteristics of the industry log consumption and disposition of mill residues. Accompanying the tables is a descriptive analysis of conditions and trends in the industry.

KEYWORDS: Forest products industry, wood utilization, wood waste utilization, mill operations/products, Oregon.

Ta

F

North

West

South
Blu

All A

The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Developing and evaluating alternative methods and levels of resource management.
3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research are made available promptly. Project headquarters are at:

Fairbanks, Alaska
Juneau, Alaska
Bend, Oregon
Corvallis, Oregon
La Grande, Oregon
Portland, Oregon
Olympia, Washington
Seattle, Washington
Wenatchee, Washington

Mailing address: Pacific Northwest Forest and Range Experiment Station
P.O. Box 3141
Portland, Oregon 97208

The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

The U.S. Department of Agriculture is an Equal Opportunity Employer. Applicants for all Department programs will be given equal consideration without regard to race, color, sex or national origin.

USDA Forest Service Resource Bulletin PNW-80
1978

CLEMSON UNIVERSITY LIBRARY
JAN 12 1979
SCI., TECH. & AGR. DIV.

CALIFORNIA'S FOREST INDUSTRY, 1976

Bruce A. Hiserote
James O. Howard

GOVT. DOCUMENTS
DEPOSITORY ITEM
JAN
CLEMSON
LIBRARY

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE
PORTLAND, OREGON

Highlights

INDUSTRY CHARACTERISTICS

- Total number of mills was 200:

Type of mill	Number	Capacity
Sawmills	142	16.2 MMBF (8-hour shift)
Veneer and plywood	21	3.7 MMSF (8-hour shift)
Pulp	7	2,260 tons (daily)
Board	10	76.6 MMSF (annually)
Log export	7	--
Shake and shingle	7	138 squares (8-hour shift)
Post, pole, and piling	6	40.6 MMBF (annually)

- Humboldt, with 47 mills, was the leading county in number of mills.
- The 63 largest sawmills had 67 percent of the total sawmill capacity.

WOOD CONSUMPTION

- 4.69 billion board feet of roundwood (logs) were consumed.
- 2.3 million bone-dry tons of chips, shavings, sawdust, and bark were consumed by the pulp and board industry.
- Leading counties in roundwood use were:

	Million board feet
Humboldt	1,165
Mendocino	449
Shasta	417
Siskiyou	398

- Roundwood use by industry:

	Percent
Sawmills	86.0
Veneer and plywood	11.5
Log export	2.1
Other industries	.4

- Roundwood accounted for less than 1 percent of wood use by pulp and board industry.
- 70 percent of all logs were old growth.
- 96 percent of all logs were sound.
- 27 percent of all logs were Douglas-fir; 25 percent ponderosa and sugar pines; 20 percent redwood; and 19 percent true firs.
- 48 percent of all logs came from forest industry lands; 37 percent from National Forests.

MILL RESIDUES

- 7.3 million tons of wood and bark residue were generated, 89 percent from sawmills.
- 77 percent of all residue was wood; 23 percent was bark.
- 89 percent of wood residue and 65 percent of bark were used.
- 56 percent of wood residue went to the pulp and board industry; 26 percent for fuel; 7 percent miscellaneous; and 11 percent unused.
- 36 percent of bark residue was used as fuel; 29 percent miscellaneous; and 35 percent unused.

CALIFORNIA'S FOREST INDUSTRY, 1976

REFERENCE ABSTRACT

Hiserote, Bruce A., and James O. Howard.
1978. California's forest industry, 1976. USDA For. Serv. Resour. Bull. PNW-80, 95 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

This report presents the findings of a 100-percent canvas of the primary forest products industry in California for 1976. Tabular presentation includes characteristics of the industry log consumption and disposition of mill residues. Accompanying the tables is a descriptive analysis of conditions and trends in the industry.

KEYWORDS: Forest products industries, wood utilization, wood waste utilization, mill operation/products, California.

RESEARCH SUMMARY

Resource Bulletin PNW-80

1978

This report presents the findings of a survey of the primary wood processing industry in California, 1976. Data were obtained on log consumption and mill characteristics of the lumber; veneer and plywood; pulp and board; shake and shingle; post, pole, and piling; and export industries.

The 200 mills that comprised California's forest industry in 1976 consumed 4,687,813,000 board feet of logs and created 7,296,536 tons of mill residue. The lumber and veneer and plywood industries accounted for over 97 percent of the wood consumed and 99 percent of the residues produced.

Preface

This report presents the results of a survey of the primary wood processing industry in California for 1976. This survey identifies the raw material inputs, both logs and mill residues, and the characteristics of the forest products industries. Data are shown separately for the following industries: lumber, veneer and plywood, pulp and board, shake and shingle, post, pole, and piling, and export.

Surveys of wood use by the California forest industries were conducted by the Pacific Southwest Forest and Range Experiment Station in 1946, 1951, 1956, and 1962. Surveys similar to the present one were jointly conducted in 1968 by the California Division of Forestry and the Pacific Northwest Forest and Range Experiment Station and in 1972 by the Pacific Northwest Forest and Range Experiment Station. The earlier surveys differ principally from the latest three in that they did not include information about the processing facilities.

Data for 1976 were obtained from a 100-percent mail and telephone canvass of all primary processors of wood conducted during 1977. Industry contacts for the survey were based on a mill list from the 1972 survey, updated with the assistance of the California Division of Forestry.

As this survey represents a 100-percent canvass, no sampling error is involved. The information collected from each mill is assumed to be the most reliable and best available. Where possible, the data came from records; in some instances, however, estimates were made by mill officials. Information for individual mills is strictly confidential; information that could reveal critical detail of individual operations has been combined with other data to avoid disclosure.

Data for log consumption and product output are actual figures as reported by the mills. Subsequent classification of these data, i.e., by species, ownership origin, etc., are based on percentage distributions provided by the mills and may not agree precisely with other published figures. Statistics on mill residues are based on average factors applied to product output (see appendix). As such, they may differ from actual volumes for a given mill.

Supporting data is presented in tables 1-71 (Appendix II) at the end of this report. In the tables, "--" indicates the value is either "0" or not available.

Acknowledgments

Appreciation is extended to the mill owners and operators who cooperated in order to provide the data for this report and to the major forest industry associations for their support of this study. Special acknowledgment is made to the following:

- State of California, Division of Forestry, for assistance in updating the mill list, and sharing their knowledge of the forest industries of California.
- State of Washington, Department of Natural Resources, particularly John A. Bergvall, Forest Analyst, for assistance in processing the data and technical advice on methodology and questionnaires.

METRIC CONVERSIONS

1,000 cubic feet = 28.317 cubic meters
1 ton (2,000 lbs.) = 907.184 kilograms
1 square foot = 0.092903 square meter
1,000 square feet, 3/8-inch basis = 92.903 square meters, 0.9525 centimeter basis

Contents

Page

THE FOREST INDUSTRY IN PERSPECTIVE 1

CHARACTERISTICS 3
- Number of Mills Continues to Decrease 3
- Humboldt County Still First in Size of Forest Industry . . . 5
- Sawmills Continue as Largest Segment of Industry 5
- Trend Toward Fewer but Larger Sawmills Continues 5
- Sixteen-Percent Decrease in Number of Veneer and Plywood Mills 7
- Since 1972, Hardboard Capacity is Up Pulp Capacity is Down . 7
- Twenty Operations Identified in "Other Industry" Sector . . 8

WOOD CONSUMPTION 8
- Total Roundwood Consumption for 1976 Down 14 Percent 8
- Roundwood Consumption of "Other Industry" Sector Increased 19 Percent 8
- Roundwood Consumption Decreased in All Resource Areas . . . 8
- Humboldt, Mendocino, and Shasta Counties Lead in Roundwood Consumption 8
- Sixty-One Percent of Logs Come From Private Lands 9
- Dependency From One Owner Class for Logs is Decreasing . . . 9
- Little Change in Species Mix 9
- Use of Young-Growth Timber Continues to Increase 10
- Mill Residues Constitute 99 Percent of Input to Pulp and Board Industry 10

MILL RESIDUES. 11
- Forest Industry Residues Total 7.3 Million Tons 11
- Eighty-Nine Percent of Wood Residue is Used 11
- Over 65 Percent of Bark Residue is Used 11
- Residue From Plywood Industry Has Greatest Use 11
- Use of Wood Residues From Large Sawmills is Greater Than From Small Sawmills 12

APPENDIX I 13
- Measurement Units 13
- Mill Residues 13

APPENDIX II 17

The Forest Industry in Perspective

California is a major producer of many wood products. In 1976, California produced 5.3 billion board feet of lumber, 14 percent of the Nation's total[2] (fig. 1). Plywood production in 1976 amounted to just under 4 percent of the national total. California's pulp industry produced over 800,000 tons of wood pulp in 1976. Particleboard production for the year was nearly 20 percent of the Nation's total, while hardboard was only about 4 percent of the total national production. The volume of logs exported from California ports in 1976 accounted for 4 percent of the logs exported from the Western States.

The forest industry has long been an important part of the State's economy. In 1976, the industry employed an average of 96,500 people, with an annual payroll of over $1 billion.[2] These figures are total employment and payroll figures, including both primary and secondary wood and paper processing and manufacture. The industry's contribution extends beyond this in the form of payments of State and local taxes, and purchase of labor, services, and materials that generate income throughout the economy. The importance of the industry is felt more at local levels, particularly in the northern part of the State. Specific areas, such as Humboldt County, derive as much as 90 percent of their manufacturing employment from the timber industry. In some towns, the forest industry may represent the only nonservice employment. Urban areas, however, with large service sectors rely very little on employment from primary processing of wood, although secondary manufacturing may be of greater importance.

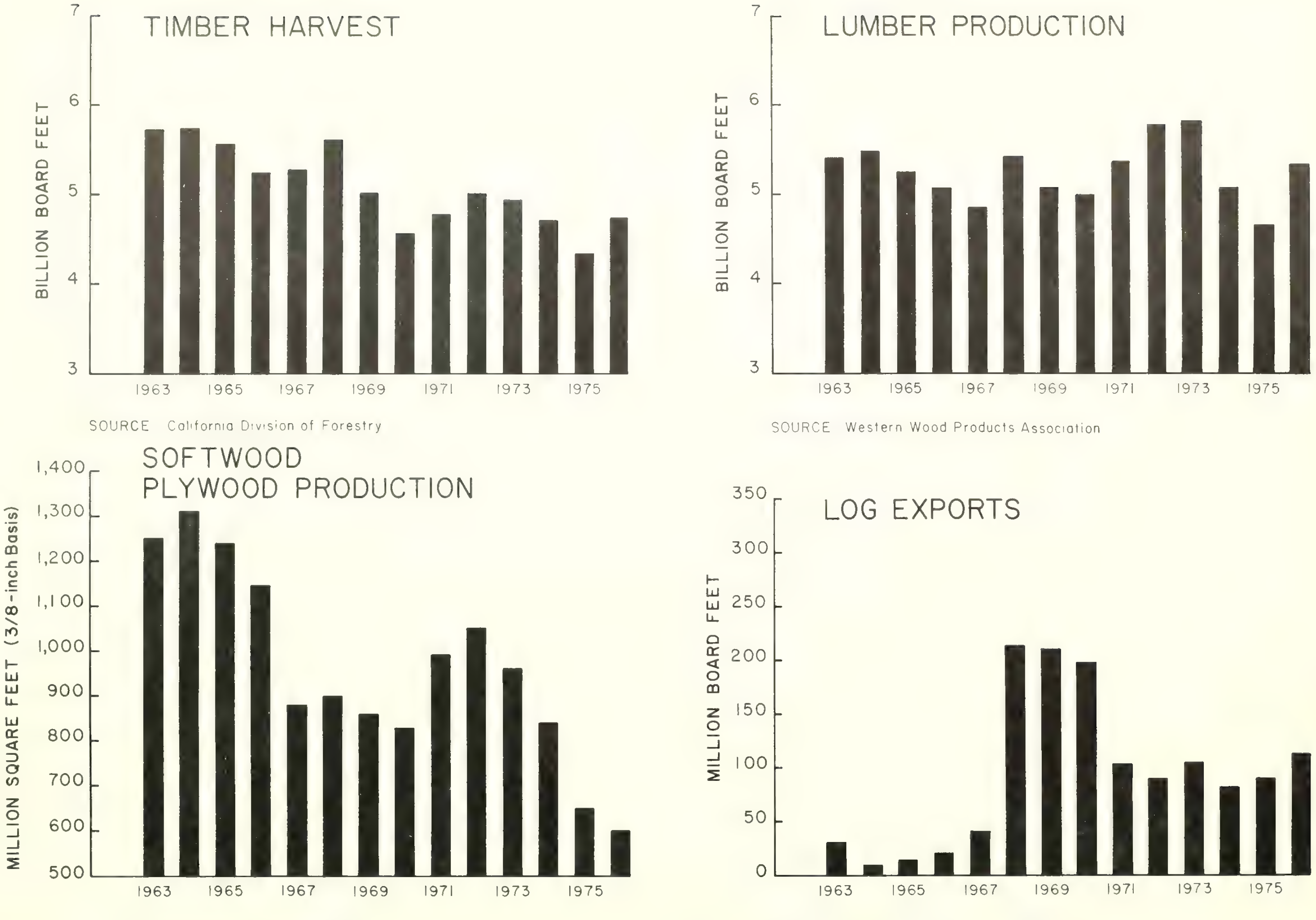
California has been divided into two timber producing regions--coastal and interior (fig. 2). The coastal region consists of the counties west of the crest of the Coast Ranges, from Monterey County to the Oregon border. This region contains all of the coastal redwood forests, as well as extensive stands of Douglas-fir. Within this region are two resource areas, defined by the nature of their timber resource and timber trading patterns. The north coast is the most important timber producing area in California, as well as the center for redwood and Douglas-fir processing (fig. 3). The forest industry of the north coast is the most diversified in California, with all types of primary wood processing represented (fig. 2). The forest industry of the central coast is not nearly as significant, having limited timber resources. Three of the State's pulpmills[3], however, are located in the central coast area.

---

[1] Western Wood Products Association. 1976 Statistical Yearbook. 1977.

[2] California Department of Human Resources Development. California unemployment insurance reporting units by size, industry, and county. Published quarterly.

[3] Each pulp or board process at a location is considered to be a "mill."



SOURCE California Division of Forestry

SOURCE Western Wood Products Association

SOURCE: American Plywood Association

SOURCE: U.S. Department of Commerce

Figure 1.--Output of major timber products in California, 1962-1976.

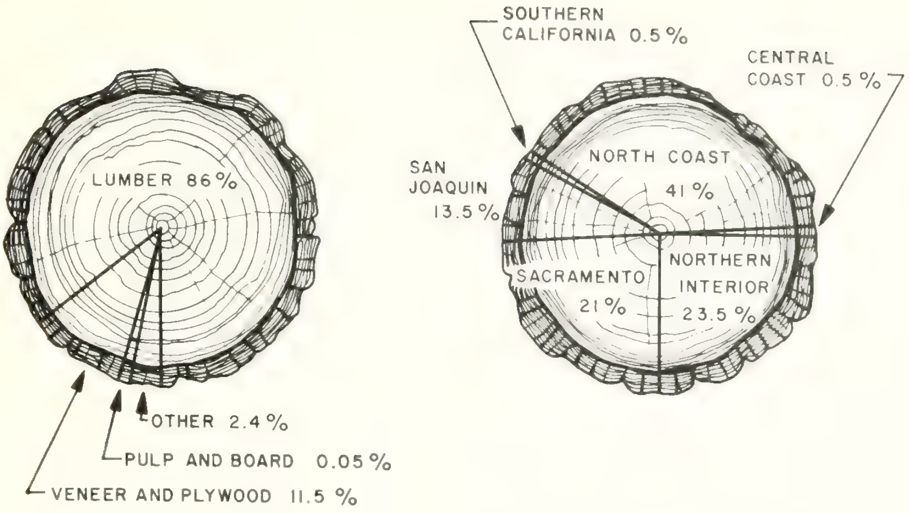


Figure 2.--Number of mills by wood producing regions and resource areas.

The interior region is divided into four resource areas, covering a wide diversity of forest types, including pines, incense-cedar, Douglas-fir, true firs, and a mixed-conifer type. The importance of the forest industry and resource decreases from north to south. The northern interior, Sacramento, and San Joaquin areas are major timber producers, and support a significant industry. The forest industry in the southern California area is very limited in size, supported by a small timber resource base. The forest industry of the interior region is less diversified than that of the coastal region. Sawmills comprise about 78 percent of its industry, compared with 63 percent for the coastal region.

Characteristics

NUMBER OF MILLS CONTINUES TO DECREASE

The 200 mills that comprised California's forest industry in 1976 reflect a decrease of 16 percent since 1972--a decrease of 27 percent since 1968. The decline in the number of mills continues a trend set

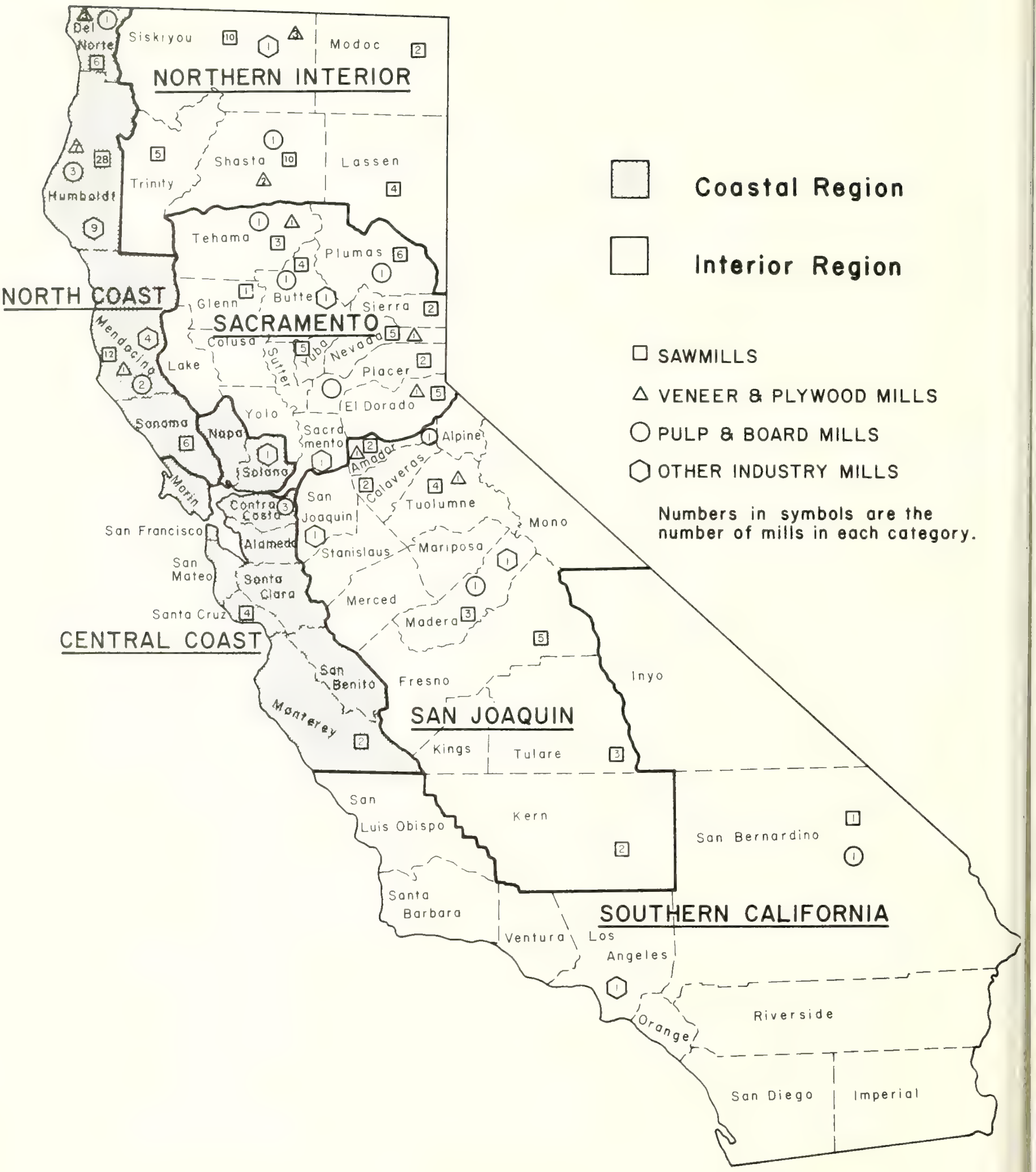


Figure 3.--Distribution of roundwood consumption by industry and area, 1976.

in the early 1950's, following a rapid post-war increase in the size of the industry. As in the past, the major segment of the industry is located in the three northernmost resources areas (north coast, northern interior, and Sacramento), which contain over 80 percent of the State's commercial forest area.[4/] These areas contain 80 percent of the mills identified in this survey. There has been a general decrease in the number of mills in all resource areas as shown on page 6. Since 1968, the greatest change has been in the coastal region (North Coast and Central Coast) with a 30-percent decrease in the number of mills. During the same period, the interior region had a 24-percent decrease. Since 1972 however, the interior area has experienced the greatest decline.

HUMBOLDT COUNTY STILL FIRST IN SIZE OF FOREST INDUSTRY

Among the six resource areas in the State, the north coast maintained its lead with 82 mills, 41 percent of the total, and 41 percent of the total roundwood consumption (1,925 million board feet) in 1976. As in the past, Humboldt County led all counties in roundwood consumption with 1,165 million board feet, 25 percent of the State's total. Over 23 percent of all operating mills are in the county. The seven veneer and plywood mills account for 36 percent of the State's capacity. Humboldt County also has one-quarter of the sawmill capacity, nearly half of the State's pulp capacity and about 15 percent of the board capacity. In addition, the major portion of the State's log exports go through the Port of Eureka in Humboldt County.

SAWMILLS CONTINUE AS LARGEST SEGMENT OF INDUSTRY

The operation of sawmills continues to be the major activity of the forest industry in California. Although the number of sawmills in the State has decreased since 1972, the lumber industry still accounted for 86 percent of the roundwood consumption in 1976. The 142 operating sawmills processed 4,035 million board feet of logs in 1976, producing nearly 5.2 billion board feet of lumber.

The plywood industry ranks second in terms of number of mills and also in roundwood consumption. The sawmill and plywood industries account for almost 98 percent of the roundwood consumption in the State.

TREND TOWARD FEWER BUT LARGER SAWMILLS CONTINUES

From a high of approximately 1,000 sawmills in 1948, the trend in the industry has been toward fewer but larger mills. This trend has been affected by increased competition for timber and efficiencies of scale within the industry. In the following tabulation, the number of mills in each of the consumption classes has declined; but the mills in the two upper classes have increased from 9 percent of the total in 1956 to 49 percent in 1976. Also, the average consumption per mill has increased from 8.7 million board feet in 1956 to 28.4 million board feet in 1976. Tabulations follow.

[4/] Daniel D. Oswald. California forest industries--prospects for the future. USDA Forest Service Resource Bulletin PNW-35, 55 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon, 1970.

Industry	Coastal region						Interior region											
	North coast			Central coast			Northern interior			Sacramento			San Joaquin			Southern California		
	1968	1972	1976	1968	1972	1976	1968	1972	1976	1968	1972	1976	1968	1972	1976	1968	1972	1976
Lumber	86	63	52	7	6	6	45	37	29	44	39	33	29	28	21	5	3	1
Veneer and plywood	17	15	11	0	0	0	5	5	5	3	3	3	1	2	2	0	0	0
Pulp and board	5	6	6	5	4	3	3	2	1	2	2	4	0	2	2	2	2	1
Other	8	12	13	4	0	1	0	1	1	3	2	2	1	3	2	0	1	1
Total	116	96	82	16	10	10	53	45	36	52	46	42	31	35	27	7	6	3

Annual consumption class (million board feet)	1956		1962		1968		1972		1976	
	Number	Volume consumed	Number	Volume consumed	Number	Volume consumed	Number	Volume consumed	Number	Volume consumed
		Million board feet		Million board feet		Million board feet		Million board feet		Million board feet
50.0+	12	800	10	864	18	1,364	28	2,044	22	1,534
25.0 - 49.9	49	1,711	49	1,791	55	2,061	52	1,748	47	1,617
5.0 - 24.9	231	2,721	133	1,725	91	1,244	59	863	53	862
0.001 - 4.9	382	609	83	119	52	63	37	40	20	22
All classes	674	5,841	275	4,499	216	4,732	176	4,695	142	4,035

Another indication of the trend toward larger mills is shown in the data below. Although the total number of mills has shown a steady decrease, the number of mills with an 8-hour capacity of greater than 120,000 board feet has shown a steady increase. At the same time the number of mills in all other classes has been decreasing.

Total 8-hour shift capacity by size class

Board-foot capacity per 8-hour shift	1968		1972		1976	
	Number of mills	8-hour shift capacity	Number of mills	8-hour shift capacity	Number of mills	8-hour shift capacity
		Thousand board feet		Thousand board feet		Thousand board feet
120,000+	31	5,255	52	8,893	63	10,872
80,000 - 119,000	67	6,077	54	5,098	39	3,685
40,000 - 79,999	69	4,092	34	2,066	23	1,402
less than 40,000	49	645	36	495	17	215
All classes	216	16,069	176	16,552	142	16,174

SIXTEEN-PERCENT DECREASE IN NUMBER OF VENEER AND PLYWOOD MILLS

Since 1972, there has been a net loss of four mills in the veneer and plywood industry. This was a 16-percent decrease in the number of mills. Since its beginning after World War II, California's plywood industry has been concentrated in the North Coast area near the Douglas-fir resource. Since 1968 there has been a 35-percent decrease in the number of plywood mills in this region. During the same period, the plywood industry in the interior region has remained very stable, at 10 mills, an increase of 1 mill since 1968. The 21 operating plywood mills consumed 539 million board feet of logs in 1976, nearly 12 percent of the State's roundwood consumption.

SINCE 1972, HARDBOARD CAPACITY IS UP PULP CAPACITY IS DOWN

Since 1972 the capacity of the hardboard industry has increased 41 percent. This was accounted for by the addition of a plant in the Sacramento unit. The number of particle board plants remained the same, but the capacity of these plants was increased by about one-quarter. The number of pulp operations declined by two, accompanied by a 13-percent decrease in the daily capacity. The majority of the pulp and board plants are located in the three northern resource areas, where most of the raw material supply--mill residues--is located.

TWENTY OPERATIONS IDENTIFIED IN "OTHER INDUSTRY" SECTOR

The "other industry" sector, which includes export, shake and shingle, and post, pole, and piling industries has remained relatively stable since 1972. The 20 operations identified in this sector account for only 2.4 percent of the total roundwood consumption in the State. The total 1976 consumption of 111 million board feet was a 21-percent increase over the 1972 figure. The major factor in this increase was a 29-percent increase in the volume of log exports. The entire shake and shingle industry and most of the export industry are located in the north coast area. The post, pole, and piling industry is scattered throughout the State.

Wood Consumption

TOTAL ROUNDWOOD CONSUMPTION FOR 1976 DOWN 14 PERCENT

In 1976, the forest industry in California consumed a total of 4.69 billion board feet of roundwood, a 14-percent decrease from the 5.45 billion-board foot consumption in 1972. As in the past, the lumber industry was the major user of roundwood, consuming 86 percent, followed by the veneer and plywood industry, with 11.5 percent. Log exports accounted for 2.1 percent of the roundwood consumed, and the pulp and board industry used only 2.7 million board feet of logs, less than one-tenth of 1 percent of the total (fig. 2). The north coast area accounted for 41 percent of the total consumption, followed by the northern interior and Sacramento areas, with 23.5 and 21 percent, respectively.

ROUNDWOOD CONSUMPTION OF "OTHER INDUSTRY" SECTOR INCREASED 19 PERCENT

While roundwood consumption for the industry as a whole decreased since 1972, consumption by the "other industry" sector has increased by 19 percent. The major factor in this increase was the increase in log exports from California ports. In 1976, the export volume was 98 million board feet, an increase of 22 million board feet over the 1972 volume.

ROUNDWOOD CONSUMPTION DECREASED IN ALL RESOURCE AREAS

Roundwood consumption decreased in all resource areas in 1976. The San Joaquin area had the smallest decline of any area between 1972 and 1976, going from 661 million board feet to 634 million board feet. During the preceding period, 1968 to 1972, San Joaquin was the only area to show a major increase in log consumption. The north coast had a decrease of 243 million board feet or 11 percent from 1972 to 1976. Log consumption declined by 18 percent in both the northern interior and the Sacramento areas, decreasing 245 and 211 million board feet respectively. The 1976 consumption in the central coast decreased to half of what it was in 1972. This was caused by a general decline in the consumption by all mills in the area.

HUMBOLDT, MENDOCINO, AND SHASTA COUNTIES LEAD IN ROUNDWOOD CONSUMPTION

In 1976, the forest industry in Humboldt County was again the leader in log consumption, accounting for nearly one-quarter of the State's log consumption. Mendocino County was second, using 449 million board feet, followed by Shasta County, with 417 million board feet. The fourth leading county was Siskiyou, with 398 million board feet, dropping from second in consumption in 1972. The mills in these four counties account for over 50 percent of the total roundwood consumption in California.

Humboldt County also leads all counties as a producer of logs. 1,073 million board feet of logs originated in Humboldt County--over twice the volume of the next largest producer, Mendocino County. About 87 percent of the logs originating in Humboldt County were used in the county.

SIXTY-ONE PERCENT OF LOGS COME FROM PRIVATE LANDS

In 1976, the consumption of logs from private lands totaled 2.9 billion board feet, 61 percent of the total volume used by the forest industry. As shown in the data below, this is an increase in the proportion of timber from private lands. The only increase in consumption was from forest industry-owned lands.

	1968	1972	1976
		Percent	
National Forest	40	41	37
Other public	4	3	2
Forest industry:			
Own lands	27	31	34
Other lands	9	8	14
Farmer and miscellaneous private	20	17	13

In 1976, the forest industry used 1,725 million board feet of logs from National Forest land. The Shasta-Trinity National Forest led all California Forests with 316 million board feet, 18 percent of the total. The next three largest producers of logs were the Six Rivers, Sierra, and Tahoe National Forests. These four Forests accounted for 47 percent of the logs originating on National Forest lands. Sawmills used nearly 91 percent of the National Forest logs, while the plywood industry used about 9 percent.

DEPENDENCY FROM ONE OWNER CLASS FOR LOGS IS DECREASING

The exclusive dependency of mills for logs from a single ownership class has been decreasing since 1968. There is a general tendency for mills to obtain their log supply from a variety of sources. There has also been a general decrease in logs supplied by farmer and miscellaneous private lands.

LITTLE CHANGE IN SPECIES MIX

Although there was a general decrease in the consumption of all major species between 1972 and 1976, the percentage of the total consumption for each species changed very little. As shown below, the consumption of Douglas-fir logs, after decreasing from 40 percent of the total consumption in 1956 to 27 percent in 1972, continued to lead with 27 percent of the total volume consumed in 1976. The consumption of true firs and redwoods each accounted for about one-fifth of the total consumption in 1976, changing little from 1972. The consumption of pine has accounted for about one-quarter of the consumption in the past as it did in 1976. Sugar pine accounted for about 4 percent and the rest was ponderosa pine.

Log Consumption (percent)

Year	Douglas-fir	True firs	Redwood	Pines	Other
1946	19	15	10	53	3
1956	40	12	18	24	6
1962	38	15	17	23	7
1968	32	22	18	24	4
1972	27	22	19	25	7
1976	27	20	20	25	8

USE OF YOUNG-GROWTH TIMBER CONTINUES TO INCREASE

The use of young-growth timber[5] continues to increase in the State. In 1976, the forest industry used 1,423 million board feet of young-growth logs, 30 percent of the total roundwood consumption. The trend toward greater use of young-growth logs will continue throughout the State as the old-growth timber is removed.

The forest industry in the area from Monterey County north through Mendocino County uses young-growth logs as a major share of their supply. In 1976, the sawmills in this area consumed 350 million board feet of young-growth logs, 68 percent of the industry's total consumption. Also in Butte County, in the northern Sierra mining region, young-growth logs accounted for over 50 percent of the volume consumed.

Seventy percent of the logs consumed by the export industry were young-growth logs; over 90 percent of the logs consumed by the post, pole, and piling industry were young growth. The lumber and plywood industries rely on young-growth logs for 30 and 23 percent of their respective log consumption.

The shake and shingle industry is totally dependent on old-growth logs.

MILL RESIDUES CONSTITUTE 99 PERCENT OF INPUT TO PULP AND BOARD INDUSTRY

In 1976, the pulp and board industry consumed 2,344,280 tons of wood fiber, about the same as in 1972. Ninety-nine percent of the volume consumed was residues from primary manufacture of logs. Logs chipped by the mills themselves amounted to 10,800 tons, one-quarter of the amount in 1972, while wood fiber from other sources was only 7,236 tons, down from 152,000 tons in 1972. The low volume of logs used by the industry indicates that other sources of wood fiber are more readily available.

The use of sawdust and shavings has increased 61 percent since 1972, from 433,527 to 700,126 tons annually.[6] The increase almost made up for the 15-percent decrease in chip consumption between 1972 and 1976. The decrease in chip consumption resulted from closure of two pulpmills, while the increase in sawdust and shaving consumption resulted from the installation of a new hardboard plant, and increased consumption by board plants in general.

---

[5] Logs from trees less than 100 years old.

[6] These figures contain an insignificant volume of bark.

Mill Residues

FOREST INDUSTRY RESIDUES TOTAL 7.3 MILLION TONS

In 1976, the forest industry created 7,296,536 tons of mill residue during primary manufacture of logs. Wood residue amounted to 5.6 million tons and bark residue 1.6 million tons. Nearly 90 percent of the residue resulted from lumber production, while 10 percent was produced by the manufacture of plywood and veneer. A very small amount, 1,463 tons, was produced by the shake and shingle industry. The forest industry in the north coast area accounted for over 41 percent of the total residue in the State.

EIGHTY-NINE PERCENT OF WOOD RESIDUE IS USED

Of the 5,647,440 tons of wood residue generated by the forest industry, 89 percent was used for various purposes. This represents a 4-percent increase over the amount of wood residue used in 1972. Almost 56 percent of the wood residue produced went to the pulp and board industry. This figure includes export chips and residues used by the pulp and board plants as boiler fuel as well as input into the manufacturing process. Also included is residue sent to Oregon pulp and board plants. Almost 26 percent of the wood residue was used for fuel by the producing mill or was sold for that purpose. An additional 7 percent was used for miscellaneous purposes.

OVER 65 PERCENT OF BARK RESIDUE IS USED

In 1976, the amount of bark residue produced during the primary processing of logs was 1,649,000 tons. Over 65 percent of this was used in some way, a 20-percent increase over the volume used in 1972. Of the total volume used, about 55 percent was for fuel, the other 45 percent was used for miscellaneous purposes such as mulch, animal bedding, and landscaping.

RESIDUE FROM PLYWOOD INDUSTRY HAS GREATEST USE

The figures below show that the use of mill residues is greatest in the plywood industry.

	Wood residue		Bark residue	
Industry	Used	Unused	Used	Unused
	- - - - - - - - -	Percent	- - - - - - - - -	
Lumber	87	13	65	35
Plywood	97	3	66	34
Shake and shingle	56	44	1	99
All industries	89	11	65	35

The plywood industry produced 570,000 tons of wood residue in 1976. Nearly 359,000 tons, 63 percent, was sent to the pulp and board industry or was exported. This was 141,000 tons less than in 1972. About 21 percent, 121,000 tons, was used as fuel and 72,000 tons for miscellaneous purposes, including lumber manufacture from cores. The 97 percent total usage was a slight increase from the 95 percent used in 1972. Of the 176,000 tons of bark residue produced by the plywood industry, nearly 50 percent was used as fuel and 16 percent was used for other miscellaneous purposes.

The physical characteristics of the plywood industry might possibly explain this relatively high usage of mill residues. Three factors stand out: (1) the veneer and plywood mills are concentrated in the same areas as are pulpmills and board mills, major users of the mill residues; (2) many of the veneer and plywood mills tend to be larger operations than those of the other industries, thus having residue in more economic packages, and (3) many of the plants are part of a larger, diversified milling complex, thereby creating better access to residue markets. Whatever the reason, the current situation indicates little room for expansion in the use of plywood mill residues.

USE OF WOOD RESIDUES FROM LARGE SAWMILLS IS GREATER THAN FROM SMALL SAWMILLS

The figures below indicate a strong correlation between the size of a sawmill and the percent utilization of the residue it generates. In general, the larger the mill the greater the proportion of the residue used. The larger mills generate residue in larger amounts, which facilitates marketing or internal use. A mill creating only a low tonnage of residue annually cannot afford the investment necessary to use the residue for fuel and often does not have the volume to attract outside buyers.

Board-foot capacity per 8-hour shift	Percent of own residue used		
	1968	1972	1976
120,000+	82	86	84
80,000-119,999	62	77	81
40,000- 79,999	39	52	73
Less than 40,000	16	44	46
All mills	64	79	83

Another indication of the increased use of mill residues can be seen in the decrease in the number of sawmills operating burners. In 1968, there were 175 mills operating burners; in 1972, there were 119 burners; and in 1976, there were 64 burners in operation--a 63-percent decrease since 1968. Almost 50 percent of the burners in operation in 1976 were in the north coast area. Also, the relative number of sawmills operating chippers has increased. In 1968, about 52 percent of the mills operated chippers; although in 1976, over 82 percent were operating chippers. There were similar decreases in burner use and increases in the use of chippers in the veneer and plywood industry as well.

Appendix I

MEASUREMENT UNITS

Most of the mills using logs reported their roundwood consumption in Scribner scale. The major exception occurred in the north coast area where Humboldt and Spaulding scales were used by mills processing redwood. Other types of measurement units used are: cords, bolts, shake blocks, pieces, tons, cunits, and lineal feet.

All board-foot log volumes are reported in "local scale." No attempt was made to account for variations in scaling standards or to convert to a common scale.

The board foot is the unit of measure used in this report for all wood consumption with the exception of purchased or transferred veneer consumed by plywood mills (square feet, 3/8-inch basis) and mill residues consumed by pulpmills and board mills (tons, dry weight). Consumption by mills not reported in these units was converted using the following factors:

1 cord = 500 board feet
1 ton = 500 board feet
10.5 squares = 1,000 board feet
1 lineal foot = 3.8 board feet
1 cubic foot = 6 board feet
200 cubic-foot units = 1 bone-dry ton
1 bone-dry unit = 1.2 bone-dry tons

Board-foot lumber tally is the unit of measure used for lumber production; square feet, 3/8-inch basis for veneer and plywood production; square (100 square feet) for shake and shingle production; and board-foot "local scale" for log export and post, pole, and piling shipments.

MILL RESIDUES

In this study no attempt was made to get individual mills to quantify the amount of residue produced. The reason for this was that although mills might be able to specify amounts of residue sold for high value uses, such as pulp chips, the lower value uses such as mulch or fuel are difficult to quantify. Therefore, the mills were asked to indicate only the percentage distribution of the disposal of their residues. These percentages were then applied to residue estimates derived through use of the following factors:

Softwood Sawmill Residue,
White Woods[1]

Average quantity of residues developed from producing 1,000 board feet of lumber.

Item	Dry weight
	(Tons)
Wood residue:	
Slabs, edgings, sawmill trim	0.508
Planer trim	.038
Sawdust	.279
Planer shavings	.203
Total wood residue	1.028
Bark	.285
All residue	1.313

Softwood Sawmill Residue,
Redwood and Incense-Cedar[2]

Average quantity of residues developed from producing 1,000 board feet of lumber.

Item	Dry weight
	(Tons)
Wood residue:	
Slabs, edgings, and trim	0.711
Sawdust	.225
Planer shavings	.154
Total wood residue	1.090
Bark	.300
All residue	1.390

---

[1] Based on data from Oregon mills compiled by Oregon State University School of Forestry 1967. Dry weights adjusted for different species mix utilized in California, primarily ponderosa pine and Douglas-fir.

[2] Based on data from California mills from mill-scale studies made by the U.S. Forest Service.

Softwood Plywood Residue[3]

Average quantity of residue developed in producing the equivalent of 1,000 square feet of 3/8-inch plywood (rough basis).

Item	Solid volume[4]	Dry weight
	(Cubic feet)	(Tons)
Wood residue:		
Log trim	3.4	0.046
Cores	3.7	.050
Veneer clippings, roundup, and spur trim	18.5	.250
Dry trim and layup loss	6.5	.088
Sander dust	1.6	.021
Total wood residue	33.7	.455
Bark	8.8	.132
All residue	42.5	.587

Shingle Mill Residues[5]

Average quantity of residue developed in utilizing 1,000 board feet of logs, Scribner scale, or in producing the equivalent volume of 10.5 squares.

Shake and shingle residue	Solid volume		Dry weight per MBM
	(Cubic feet)	(Percent)	(Tons)
Shingles:			
Coarse	23	13.7	0.22
Fine	78	46.8	.75
Bark	19	11.5	.28
Shakes:			
Coarse	23	13.7	.22
Fine	24	14.5	.23
Bark	19	11.5	.28
Shingle and shake:			
Coarse	23	13.7	.22
Fine	51	30.6	.49
Bark	19	11.5	.28

---

[3] Based on data compiled by Oregon State University School of Forestry from Oregon mills in 1967. Because of the similarity of species used and mills, no adjustment was made in applying these data to California.

[4] Based on equivalent green volume.

[5] From information provided by the Red Cedar Shingle Bureau.

Appendix II

Table 1--Number of mills by type of industry and resource area, California, 1976

Resource area	All industries	Industry					
		Lumber	Veneer and plywood	Pulp and board[1]	Other		
					Shake and shingle	Export[2]	Post, pole, and piling
orth Coast	82	52	11	6	7	6	--
entral Coast	10	6	--	3	--	--	1
orthern Interior	36	29	5	1	--	--	1
acramento	42	33	3	4	--	1	1
an Joaquin	27	21	2	2	--	--	2
outhern California	3	1	--	1	--	--	1
ll Areas	200	142	21	17	7	7	6

[1] Each pulping process at a location is considered an individual mill.

[2] Represents the number of identifiable operations involved in the export trade.

Table 2--Wood consumption by mills by type of material, resource area, and industry, California, 1976

Resource area and industry	Roundwood			Other[1]	Residue[2]
	All roundwood	Sound logs	Utility logs		
	Thousand board feet, local scale				Tons
North Coast					
Lumber	1,556,253	1,470,628	85,625	17,870	--
Veneer and plywood	293,919	260,653	33,266	--	--
Pulp and board	--	--	--	--	1,276,036
Shake and shingle	3,455	895	2,560	--	--
Total	1,853,627	1,732,176	121,451	17,870	1,276,036
Central Coast					
Lumber	23,822	23,822	--	--	--
Pulp and board	2,700	2,700	--	--	510,190
Total	26,522	26,522	--	--	510,190
Northern Interior					
Lumber	944,118	892,301	51,817	2,000	--
Veneer and plywood	149,861	139,326	10,535	--	--
Pulp and board[3]	--	--	--	--	285,086
Total	1,093,979	1,031,627	62,352	2,000	285,086
Sacramento					
Lumber	925,509	911,229	14,280	5,810	--
Veneer and plywood[4]	94,896	94,896	--	--	--
Pulp and board[3]	--	--	--	--	--
Total	1,024,405	1,006,125	14,280	5,810	--
San Joaquin					
Lumber[5]	585,764	581,564	4,200	--	--
Veneer and plywood[4]	--	--	--	--	--
Pulp and board[5]	--	--	--	--	262,168
Total	585,764	581,564	4,200	--	262,168
Southern California					
Lumber[5]	--	--	--	--	--
All Areas					
Lumber	4,035,466	3,879,544	155,922	25,680	--
Veneer and plywood	538,676	494,875	43,801	--	--
Pulp and board	2,700	2,700	--	--	2,333,480
Shake and shingle	3,455	895	2,560	--	--
Export[6]	97,695	97,695	--	--	--
Post, pole, and piling[6]	9,821	9,321	500	--	--
Total	4,687,813	4,485,030	202,783	25,680	2,333,480

[1] Includes peeler cores, cants used by sawmills, blocks, boards, bolts used by shake and shingle mills, and miscellaneous peeled products used by post, pole, and piling mills.

[2] Includes residues from the sawmill, veneer and plywood, and shake and shingle industries, plus chips from roundwood chipping plants.

[3] Northern Interior and Sacramento combined to avoid disclosure.

[4] Sacramento and San Joaquin combined to avoid disclosure.

[5] San Joaquin and Southern California combined to avoid disclosure.

[6] All resource areas combined to avoid disclosure.

Table 3--Log flows to mills by State of origin, resource area, and industry, California, [illegible]

(Thousand board feet, local scale)

Resource area and industry	Origin				
	Total	California	Oregon	Idaho	Other
North Coast					
Lumber	1,556,253	1,550,783	5,470	--	--
Veneer and plywood	293,919	287,269	6,650	--	--
Shake and shingle	3,455	3,455	--	--	--
Total	1,853,627	1,841,507	12,120	--	--
Central Coast					
Lumber	23,822	23,822	--	--	--
Pulp and board	2,700	2,700	--	--	--
Total	26,522	26,522	--	--	--
Northern Interior					
Lumber	944,118	939,818	4,300	--	--
Veneer and plywood	149,861	149,861	--	--	--
Total	1,093,979	1,089,679	4,300	--	--
Sacramento					
Lumber	925,509	925,509	--	--	--
Veneer and plywood[1]	94,896	94,896	--	--	--
Total	1,020,405	1,020,405	--	--	--
San Joaquin					
Lumber[2]	585,764	585,764	--	--	--
Veneer and plywood[1]	--	--	--	--	--
Total	585,764	585,764	--	--	--
Southern California					
Lumber[2]	--	--	--	--	--
All Areas					
Lumber	4,035,466	4,025,696	9,770	--	--
Veneer and plywood	538,676	532,026	6,650	--	--
Pulp and board	2,700	2,700	--	--	--
Shake and shingle	3,455	3,455	--	--	--
Export[3]	97,695	97,015	680	--	--
Post, pole, and piling[3]	9,821	8,151	1,200	231	239
Total	4,687,813	4,669,043	18,300	231	239

[1] Sacramento and San Joaquin combined to avoid disclosure.

[2] San Joaquin and Southern California combined to avoid disclosure.

[3] All resource areas combined to avoid disclosure.

Table 4—Log flows by county and out-of-State origin,

(Thousand board feet,

Resource area and county of use	Total	North Coast				Central Coast	
		Del Norte	Humboldt	Mendocino	Sonoma	Monterey	San Mateo
North Coast							
Del Norte	213,926	137,920	64,606	--	--	--	--
Humboldt	1,165,138	98,431	931,981	27,845	--	--	--
Mendocino	449,453	--	41,689	399,600	--	--	--
Sonoma	96,689	--	--	60,109	32,081	--	2,785
Total	1,925,206	236,351	1,038,276	487,554	32,081	--	2,785
Central Coast							
Contra Costa	2,700	--	--	675	--	--	--
Monterey, Santa Cruz, and Solano1/	24,622	--	--	--	--	150	9,874
Total	28,322	--	--	675	--	150	9,874
Northern Interior							
Lassen and Modoc1/	167,434	--	--	--	--	--	--
Shasta	417,292	--	25,459	--	--	--	--
Siskiyou	398,313	--	--	--	--	--	--
Trinity	111,320	--	9,600	--	--	--	--
Total	1,094,359	--	35,059	--	--	--	--
Sacramento							
Butte	90,507	--	--	--	--	--	--
El Dorado and Sacramento1/	151,357	--	--	--	--	--	--
Glenn and Tehama1/	232,417	--	--	--	--	--	--
Nevada and Placer1/	197,426	--	--	--	--	--	--
Plumas and Sierra1/	208,634	--	--	--	--	--	--
Yuba	104,960	--	--	--	--	--	--
Total	985,301	--	--	--	--	--	--
San Joaquin							
Amador, Calaveras, and San Joaquin1/	165,981	--	--	--	--	--	--
Fresno and Madera1/	181,337	--	--	--	--	--	--
Tulare and Kern1/	128,103	--	--	--	--	--	--
Tuolumne	158,885	--	--	--	--	--	--
Total	634,306	--	--	--	--	--	--
Southern California							
San Bernardino and Los Angeles1/	20,319	--	--	--	--	--	--
All Areas	4,687,813	236,351	1,073,335	488,229	32,081	150	12,659

See footnotes at end of table.

resource area, and county of use, California, 1966

local scale)

	Northern Interior					Sacramento		
Santa Cruz	Lassen	Modoc	Shasta	Siskiyou	Trinity	Butte	El Dorado	Glenn
--	--	--	--	--	--	--	--	--
--	--	--	600	4,035	100,846	--	--	--
--	--	--	--	--	7,694	--	--	--
--	--	--	--	--	--	261	--	261
--	--	--	600	4,035	108,540	261	--	261
--	--	--	--	--	--	270	--	--
13,798	--	--	--	306	306	306	--	--
13,798	--	--	--	306	306	576	--	--
--	41,592	54,644	14,587	300	--	--	--	--
--	53,134	12,516	260,822	18,982	28,036	1,600	--	3,653
--	8,462	990	57,919	310,091	15,437	1,000	--	--
--	--	--	3,082	2,350	96,288	--	--	--
--	103,188	68,150	336,410	331,723	139,761	2,600	--	3,653
--	390	--	--	514	--	55,462	205	--
--	--	--	--	--	--	--	138,212	--
--	3,992	--	16,961	--	22,309	28,425	--	50,000
--	--	--	--	--	--	--	20,990	--
--	10,188	--	4,650	--	6,975	--	--	--
--	--	--	--	--	--	19,650	--	--
--	14,570	--	21,611	514	29,284	103,537	159,407	50,000
--	--	--	--	--	--	--	43,683	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	43,683	--
--	--	--	688	494	687	--	--	--
13,798	117,758	68,150	359,309	337,072	278,578	106,974	203,090	53,914

Table 4—Log flows by county and out-of-State origin,

(Thousand board

Resource area and county of use	Sacramento (Continued)									
	Lake	Nevada	Placer	Plumas	Sierra	Tehama	Yuba	Alpine	Amador	Calaveras
North Coast										
Del Norte	--	--	--	--	--	--	--	--	--	--
Humboldt	--	--	--	--	--	--	--	--	--	--
Mendocino	470	--	--	--	--	--	--	--	--	--
Sonoma	931	--	--	--	--	--	261	--	--	--
Total	1,401	--	--	--	--	--	261	--	--	--
Central Coast										
Contra Costa	--	--	--	675	135	--	--	--	306	--
Monterey, Santa Cruz, and Solano[1/]	--	--	--	--	--	306	--	--	--	--
Total	--	--	--	675	135	306	--	--	306	--
Northern Interior										
Lassen and Modoc[1/]	--	--	--	49,093	--	7,218	--	--	--	--
Shasta	--	--	--	8,523	1,810	2,757	--	--	--	--
Siskiyou	--	--	--	--	--	76	--	--	--	--
Trinity	--	--	--	--	--	--	--	--	--	--
Total	--	--	--	57,616	1,810	10,051	--	--	--	--
Sacramento										
Butte	--	6,722	3,186	20,542	3,186	--	300	--	--	--
El Dorado and Sacramento[1/]	--	--	5,223	--	--	--	--	59	7,863	--
Glenn and Tehama[1/]	--	--	--	7,988	--	102,742	--	--	--	--
Nevada and Placer[1/]	--	40,964	97,719	1,609	36,144	--	--	--	--	--
Plumas and Sierra[1/]	--	2,400	800	114,561	47,493	21,567	--	--	--	--
Yuba	--	15,358	16,639	18,527	7,349	--	27,437	--	--	--
Total	--	65,444	123,567	163,227	94,172	124,309	27,737	59	7,863	--
San Joaquin										
Amador, Calaveras, and San Joaquin[1/]	--	--	--	--	--	--	--	--	53,544	62,855
Fresno and Madera[1/]	--	--	--	--	--	--	--	--	--	42
Tulare and Kern[1/]	--	--	--	--	--	--	--	--	--	--
Tuolumne	--	--	--	--	--	--	--	--	--	3,568
Total	--	--	--	--	--	--	--	--	53,544	66,465
Southern California										
San Bernardino and Los Angeles[1/]	--	--	--	--	--	494	--	--	--	--
All Areas	1,401	65,444	123,567	221,518	96,117	135,160	27,998	59	61,713	66,465

[1/] Combined to avoid disclosure.

resource area, and county of use, California, 1966—Continued

feet, local scale)

San Joaquin							Southern California	Out-of-State
Fresno	Kern	Madera	Mariposa	San Joaquin	Tulare	Tuolumne	San Bernardino	
--	--	--	--	--	--	--	--	11,[illegible]
--	--	--	--	--	--	--	--	1,400
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	12,800
--	--	--	--	--	--	945	--	--
--	--	--	--	--	--	--	--	[illegible]
--	--	--	--	--	--	945	--	[illegible]
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	4,333
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	4,338
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	2,600	225	2,175	--	899
109,688	--	61,680	2,842	--	6,553	70	--	[illegible]
--	9,536	--	--	--	118,567	—	--	--
--	--	--	10,858	--	--	144,459	--	--
109,688	9,536	61,680	13,700	2,600	125,345	146,704	--	1,361
--	--	--	--	--	10,256	--	7,426	[illegible]
109,688	9,536	61,680	13,700	2,600	135,601	147,649	7,426	19,043

Table 5—Log flow to mills from National Forests,

(Thousand board

Resource area and county of use	All National Forests	El Dorado	Klamath	Lassen	Mendocino	Modoc
North Coast						
Del Norte	31,738	--	--	--	--	--
Humboldt	176,344	--	1,292	--	--	--
Mendocino	33,632	--	--	--	25,291	--
Sonoma	--	--	--	--	--	--
Total	241,714	--	1,292	--	25,291	--
Central Coast						
Monterey, Santa Cruz, and Solano[1]	180	--	--	--	--	--
Northern Interior						
Lassen and Modoc[1]	157,765	--	--	63,687	--	54,181
Shasta	131,378	--	--	35,796	2,045	9,642
Siskiyou	149,886	--	107,830	945	--	630
Trinity	112,282	--	2,115	—	--	--
Total	551,311	--	109,945	100,428	2,045	54,453
Sacramento						
Butte	21,126	--	--	7,392	123	--
El Dorado and Sacramento[1]	38,265	38,265	--	--	--	--
Glenn and Tehama[1]	101,629	--	--	7,260	60,343	--
Nevada and Placer[1]	95,450	16,076	--	--	--	--
Plumas and Sierra[1]	120,222	--	--	28,323	1,325	--
Yuba	56,626	--	--	--	--	--
Total	433,318	54,341	--	42,975	61,791	--
San Joaquin[2]						
Amador, Calaveras, and San Joaquin[1]	82,827	44,450	--	--	--	--
Fresno and Madera[1]	166,606	--	--	--	--	--
Kern, Los Angeles, Tulare, and San Bernardino[1]	138,481	--	198	--	--	--
Tuolumne	110,799	--	--	--	--	--
Total	498,713	44,450	198	--	--	--
All Areas	1,725,236	98,791	111,435	143,403	89,127	64,453

[1] Combined to avoid disclosure.

[2] San Joaquin and Southern California combined to avoid disclosure.

by *resource area and county, California, 1976*

eet, local scale)

Plumas	San Bernardino	Sierra	Sequoia	Shasta-Trinity	Six Rivers	Stanislaus	Tahoe	Out-of-State National Forests
--	--	--	--	--	31,738	--	--	--
--	--	--	--	59,563	115,489	--	--	--
--	--	--	--	--	8,341	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	59,563	155,568	--	--	--
--	--	--	--	180	--	--	--	--
39,597	--	--	--	--	--	--	--	300
--	--	--	--	78,342	--	--	--	5,553
--	--	--	--	40,481	--	--	--	--
--	--	--	--	103,822	6,345	--	--	--
39,597	--	--	--	222,645	6,345	--	--	5,853
13,611	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
7,976	--	--	--	26,050	--	--	--	--
373	--	--	--	--	--	1,000	78,001	--
43,642	--	--	--	7,700	--	--	39,232	--
19,710	--	--	--	--	--	--	36,916	--
85,312	--	--	--	33,750	--	1,000	154,149	--
--	--	--	--	--	--	38,377	--	--
--	--	161,308	5,298	--	--	--	--	--
--	7,603	--	130,482	198	--	--	--	--
--	--	--	--	--	--	110,799	--	--
--	7,603	161,308	135,780	198	--	149,176	--	--
124,909	7,603	161,308	135,780	316,336	161,913	150,176	154,149	5,853

Table 6—Log flow to mills from National Forests,

(Thousand board

Resource area and county of use	All National Forests	El Dorado	Klamath	Lassen	Mendocino	Modoc
North Coast						
Lumber	199,378	--	--	--	25,291	--
Veneer and plywood	37,096	--	--	--	--	--
Pulp and board	--	--	--	--	--	--
Shake and shingle	--	--	--	--	--	--
Total	236,474	--	--	--	25,291	--
Northern Interior						
Lumber	490,735	--	66,307	100,428	2,045	61,461
Veneer and plywood	60,519	--	43,609	--	--	2,992
Pulp and board	--	--	--	--	--	--
Total	551,254	--	109,916	100,428	2,045	64,453
Sacramento						
Lumber	417,771	51,040	--	42,975	58,068	--
Veneer and plywood[1]	55,254	17,760	--	--	3,600	--
Pulp and board	--	--	--	--	--	--
Total	473,025	68,800	--	42,975	61,668	--
San Joaquin						
Lumber[2]	458,364	29,991	--	--	--	--
Veneer and plywood[1]	--	--	--	--	--	--
Pulp and board	--	--	--	--	--	--
Total	458,364	29,991	--	--	--	--
Southern California						
Lumber[2]	--	--	--	--	--	--
Pulp and board	--	--	--	--	--	--
Total	--	--	--	--	--	--
All Areas						
Lumber	1,566,248	81,031	66,307	143,403	85,404	61,461
Veneer and plywood	152,869	17,760	43,609	--	3,600	2,992
Pulp and board	--	--	--	--	--	--
Shake and shingle	--	--	--	--	--	--
Export[2]	5,240	--	1,292	--	--	--
Post, pole, and piling[3]	879	--	227	--	123	--
Total	1,725,236	98,791	111,435	143,403	89,127	64,453

[1] Sacramento and San Joaquin combined to avoid disclosure.

[2] San Joaquin and Southern California combined to avoid disclosure.

[3] All resource areas combined to avoid disclosure.

by industry and resource area, California, 1976

feet, local scale)

Plumas	San Bernardino	Sierra	Sequoia	Shasta-Trinity	Six Rivers	Stanislaus	Tahoe	Out-of-State National Forests
--	--	--	--	33,838	140,249	--	--	--
--	--	--	--	23,438	13,658	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	57,276	153,907	--	--	--
39,597	--	--	--	211,620	6,345	--	-	[illegible]
--	--	--	--	10,997	--	--	-	2,921
--	--	--	--	--	--	--	--	--
39,597	--	--	--	222,617	6,345	--	--	5,853
79,189	--	--	--	31,350	--	1,000	154,149	--
6,000	--	--	--	2,400	--	25,494	--	--
--	--	--	--	--	--	--	--	--
85,189	--	--	--	33,750	--	26,494	154,149	--
--	7,603	161,308	135,780	--	--	123,682	--	-
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	7,603	161,308	135,780	--	--	123,682	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	-	--
--	--	--	--	--	--	--	--	--
--	7,603	161,308	135,780	276,808	146,594	124,682	-	2,932
--	--	--	--	36,835	13,658	25,494		2,921
--	--	--	--	--	--	--	--	
--	--	--	--	--	--	--	--	--
--	--	--	--	2,287	1,661	--	--	--
123	--	--	--	406	--	--	--	--
124,909	7,603	161,308	135,780	316,336	161,913	150,176	154,149	5,853

Table 7—Dependency of mills for logs, by ownership

Resource area and industry	National Forest				State				Bureau of Land Management				
	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0
													Number
North Coast													
Lumber	34	9	4	5	46	5	1	--	51	1	--	--	50
Veneer and plywood	6	3	1	1	9	2	--	--	11	--	--	--	9
Pulp and board	6	--	--	--	6	--	--	--	6	--	--	--	6
Shake and shingle	7	--	--	--	5	--	1	1	7	--	--	--	7
Export	2	4	--	--	6	--	--	--	6	--	--	--	6
Total	55	16	5	6	72	7	2	1	81	1	--	--	78
Central Coast													
Lumber	6	--	--	--	6	--	--	--	6	--	--	--	6
Pulp and board	3	--	--	--	3	--	--	--	3	--	--	--	3
Post, pole, and piling	--	1	--	--	1	--	--	--	--	1	--	--	1
Total	9	1	--	--	10	--	--	--	9	1	--	--	10
Northern Interior													
Lumber	4	7	4	14	27	2	--	--	27	2	--	--	29
Veneer and plywood	--	3	1	1	5	--	--	--	5	--	--	--	5
Pulp and board	1	--	--	--	1	--	--	--	1	--	--	--	1
Post, pole, and piling	--	1	--	--	1	--	--	--	--	1	--	--	1
Total	5	11	5	15	34	2	--	--	33	3	--	--	36
Sacramento													
Lumber	4	6	15	8	32	1	--	--	33	--	--	--	33
Veneer and plywood	1	--	2	--	3	--	--	--	3	--	--	--	3
Pulp and board	4	--	--	--	4	--	--	--	4	--	--	--	4
Export	1	--	--	--	1	--	--	--	1	--	--	--	1
Post, pole, and piling	--	1	--	--	1	--	--	--	--	1	--	--	1
Total	10	7	17	8	41	1	--	--	41	1	--	--	42
San Joaquin													
Lumber	1	2	1	17	20	1	--	--	20	1	--	--	21
Veneer and plywood	--	--	1	1	2	--	--	--	2	--	--	--	2
Pulp and board	2	--	--	--	2	--	--	--	2	--	--	--	2
Post, pole, and piling	2	--	--	--	2	--	--	--	2	--	--	--	2
Total	5	2	2	18	26	1	--	--	26	1	--	--	27
Southern California													
Lumber	--	--	--	1	1	--	--	--	1	--	--	--	1
Pulp and board	1	--	--	--	1	--	--	--	1	--	--	--	1
Post, pole, and piling	--	1	--	--	1	--	--	--	1	--	--	--	1
Total	1	1	--	1	3	--	--	--	3	--	--	--	3
All Areas													
Lumber	46	27	24	45	132	9	1	--	138	4	--	--	140
Veneer and plywood	7	6	5	3	19	2	--	--	21	--	--	--	19
Pulp and board	17	--	--	--	17	--	--	--	17	--	--	--	17
Shake and shingle	7	--	--	--	5	--	1	1	7	--	--	--	7
Export	3	4	--	--	7	--	--	--	7	--	--	--	7
Post, pole, and piling	2	4	--	--	6	--	--	--	3	3	--	--	6
Total	82	41	29	48	186	11	2	1	193	7	--	--	196

origin, resource area, and industry, California, 1976

Other public			Forest industry								Farmer and miscellaneous private			
			Own wood supply				Other wood supply							
Dependency (percent)														
1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100		1-32	33-66	67-1
of mills														
1	--	1	20	9	8	15	27	11	6	8	26	11	9	6
1	--	1	4	1	1	5	9	--	1	1	5	5	--	1
--	--	--	6	--	--	--	6	--	--	--	6	--	--	--
--	--	--	7	--	--	--	3	1	1	2	5	1	--	1
--	--	--	6	—	--	--	1	--	3	2	2	2	--	1
2	--	2	43	10	9	20	46	12	11	13	44	[illegible]	9	9
--	--	--	6	--	--	--	5	1	--	--	--	--	--	6
--	--	--	2	--	1	--	2	--	1	--	3	--	--	--
--	--	--	1	--	--	--	--	--	1	--	--	1	--	--
--	--	--	9	--	1	--	7	1	2	--	3	1	--	6
--	--	--	20	3	4	2	15	10	4	--	13	12	2	2
--	--	--	3	1	1	--	2	1	2	--	2	1	2	--
--	--	--	1	--	--	--	1	--	--	--	1	--	--	--
--	--	--	--	--	1	--	--	1	--	--	1	--	--	--
--	--	--	24	4	6	2	18	12	6	--	17	[illegible]	4	2
--	--	--	16	7	8	2	22	10	--	1	10	13	4	6
--	--	--	--	--	2	1	3	--	--	--	2	1	--	--
--	--	--	4	--	--	--	4	--	--	--	4	--	--	--
--	--	--	1	--	--	--	--	--	1	--	--	1	--	--
--	--	--	1	--	--	--	1	--	--	--	--	--	--	1
--	--	--	22	7	10	3	30	10	1	1	16	15	4	7
--	--	--	14	6	1	--	19	1	1	--	9	4	1	2
--	--	--	--	1	1	--	2	--	--	--	1	1	--	--
--	--	--	2	--	--	--	2	--	--	--	2	--	--	--
--	--	--	1	--	1	--	1	--	1	--	--	--	2	--
--	--	--	17	7	3	--	24	1	[illegible]	--	12	[illegible]	3	2
--	--	--	1	--	--	--	1	--	--	--	1	--	--	--
--	--	--	1	--	--	--	1	--	--	--	1	--	--	--
--	--	--	--	--	1	--	--	1	--	--	1	--	--	--
--	--	--	2	--	1	--	2	1	--	--	3	--	--	--
1	--	1	77	25	21	19	[illegible]	[illegible]	11	9	[illegible]	45	16	[illegible]
1	--	1	7	3	5	6	16	1	3	1	10	8	[illegible]	1
--	--	--	16	--	1	--	16	--	1	--	17	--	--	--
--	--	--	7	--	--	--	[illegible]	1	1	2	5	1	--	1
--	--	--	7	—	--	--	1	--	4	[illegible]	2	[illegible]	--	1
--	--	--	3	--	3	--	2	2	2	[illegible]	[illegible]	1	[illegible]	1
2	--	2	117	28	30	25	127	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 8—Log consumption of all mills, by ownership class, resource area, and industry, California, 1976

(Thousand board feet, local scale)

Resource area and industry	All owners	State	National Forest	Bureau of Land Management	Other public	Forest industry		Farmer and miscellaneous private
						Own wood supply	Other wood supply	
North Coast								
Lumber	1,556,253	37,501	199,378	400	18,782	802,515	240,306	257,371
Veneer and plywood	293,919	2,334	37,096	--	13,692	157,616	58,150	25,031
Shake and shingle	3,455	1,512	--	--	--	--	1,583	360
Total	1,853,627	41,347	236,474	400	32,474	960,131	300,039	282,762
Central Coast								
Lumber	23,822	--	--	--	--	--	3,623	20,199
Pulp and board	2,700	--	--	--	--	1,350	1,350	--
Total	26,522	--	--	--	--	1,350	4,973	20,199
Northern Interior								
Lumber	944,118	8,630	490,735	3,350	--	222,076	149,763	69,564
Veneer and plywood	149,861	--	60,519	--	--	19,203	51,931	18,208
Total	1,093,979	8,630	551,254	3,350	--	241,279	201,694	87,772
Sacramento								
Lumber	925,509	798	417,771	--	--	283,658	73,416	149,866
Veneer and plywood[1]	94,896	--	55,254	--	--	35,253	--	4,389
Total	1,020,405	798	473,025	--	--	318,911	73,416	154,255
San Joaquin								
Lumber[2]	585,764	831	458,364	2,100	--	54,242	17,600	52,627
Veneer and plywood[1]	--	--	--	--	--	--	--	--
Total	585,764	831	458,364	2,100	--	54,242	17,600	52,627
Southern California								
Lumber[2]	--	--	--	--	--	--	--	--
All Areas								
Lumber	4,035,466	47,760	1,566,248	5,850	18,782	1,362,491	484,708	549,627
Veneer and plywood	538,676	2,334	152,869	--	13,692	212,072	110,081	47,628
Pulp and board	2,700	--	--	--	--	1,350	1,350	--
Shake and shingle	3,455	1,512	--	--	--	--	1,583	360
Export[3]	97,695	--	5,240	--	--	--	66,351	26,104
Post, pole, and piling[3]	9,821	--	879	303	--	1,859	2,885	3,895
Total	4,687,813	51,606	1,725,236	6,153	32,474	1,577,772	666,958	627,614

[1] Sacramento and San Joaquin combined to avoid disclosure.

[2] San Joaquin and Southern California combined to avoid disclosure.

[3] All resource areas combined to avoid disclosure.

Table 9—Log consumption by all mills by species, resource area, and industry, California, 1976

(Thousand board feet, local scale)

Resource area and industry	All species	Douglas-fir	Hemlock	True firs	Redwood	Ponderosa pine	Sugar pine	Incense-cedar	Other softwoods	Hardwoods
North Coast										
Lumber	1,556,253	548,099	13,922	44,261	862,447	55,124	3,668	4,505	22,624	1,603
Veneer and plywood	293,919	241,523	6,758	6,775	32,771	2,617	--	--	3,275	200
Shake and shingle	3,455	--	--	--	--	--	--	--	3,455	--
Total	1,853,627	789,622	20,680	51,036	895,218	57,741	3,668	4,505	29,354	1,803
Central Coast										
Lumber	23,822	3,757	--	--	19,965	--	--	--	50	50
Pulp and board	2,700	1,755	945	--	--	--	—	--	--	--
Total	26,522	5,512	945	--	19,965	--	--	--	50	50
Northern Interior										
Lumber	944,118	214,309	3,409	198,127	--	372,474	56,240	77,550	16,165	5,844
Veneer and plywood	149,861	56,679	--	56,991	--	26,700	--	--	9,491	--
Total	1,093,979	270,988	3,409	255,118	--	399,174	56,240	77,550	25,656	5,844
Sacramento										
Lumber	925,509	148,217	--	314,802	--	310,114	63,866	44,954	[illegible]	[illegible]
Veneer and plywood[1]	94,896	7,734	--	78,872	--	8,290	--	--	--	--
Total	1,020,405	155,951	--	393,674	--	318,404	63,866	44,954	43,496	[illegible]
San Joaquin										
Lumber[2]	585,764	9,280	--	226,366	--	223,952	54,288	66,230	[illegible]	[illegible]
Veneer and plywood[1]	--	--	--	--	--	--	--	--	--	--
Total	585,764	9,280	--	226,366	--	223,952	54,288	66,230	5,596	[illegible]
Southern California										
Lumber[2]	--	--	--	--	--	--	--	--	--	--
All Areas										
Lumber	4,035,466	923,662	17,331	783,556	882,412	961,664	178,062	193,239	87,931	7,609
Veneer and plywood	538,676	305,936	6,758	142,638	32,771	37,607	--	--	12,766	200
Pulp and board	2,700	1,755	945	—	--	--	--	--	--	--
Shake and shingle[3]	3,455	—	—	--	--	--	--	--	3,455	--
Export[3]	97,695	45,282	36,971	4,895	--	8,480	--	[illegible]	1,097	[illegible]
Post, pole, and piling[3]	9,821	5,537	—	180	--	4,085	--	--	[illegible]	--
Total	4,687,813	1,282,172	62,005	931,269	915,183	1,011,836	178,062	194,209	[illegible]	7,809

[1] Sacramento and San Joaquin combined to avoid disclosure.

[2] San Joaquin and Southern California combined to avoid disclosure.

[3] All resource areas combined to avoid disclosure.

Table 10—Production and disposition of wood and bark residues by mills by use,

(Tons,

Resource area and residue-producing industry	Wood residue					
	All wood	Used[1]				Unused
		Total	Pulp and board	Fuel	Miscellaneous	
North Coast						
Lumber	2,014,341	1,730,526	1,183,541	366,651	180,334	283,815
Veneer and plywood	325,858	321,349	179,202	104,573	37,574	4,509
Shake and shingle	902	506	--	118	388	396
Total	2,341,101	2,052,381	1,362,743	471,342	218,296	288,720
Central Coast						
Lumber	28,818	28,818	--	158	28,660	--
Northern Interior						
Lumber	1,082,283	945,572	507,813	437,598	161	136,711
Veneer and plywood	138,343	135,268	99,337	11,528	24,403	3,075
Total	1,220,626	1,080,840	607,150	449,126	24,564	139,786
Sacramento						
Lumber	1,352,752	1,238,775	722,540	440,495	75,740	113,977
Veneer and plywood[2]	105,667	94,526	80,332	4,627	9,567	11,141
Total	1,458,419	1,333,301	802,872	445,122	85,307	125,118
San Joaquin						
Lumber[3]	598,476	512,000	377,572	75,945	58,483	86,476
Veneer and plywood[2]	--	--	--	--	--	--
Total	598,476	512,000	377,572	75,945	58,483	86,476
Southern California						
Lumber[3]	--	--	--	--	--	--
All Areas						
Lumber	5,076,670	4,455,691	2,791,466	1,320,847	343,378	620,979
Veneer and plywood	569,868	551,143	358,871	120,728	71,544	18,725
Shake and shingle	902	506	--	118	388	396
Total	5,647,440	5,007,340	3,150,337	1,441,693	415,310	640,100

[1] Residues not necessarily used in the resource area in which produced.

[2] Sacramento and San Joaquin combined to avoid disclosure.

[3] San Joaquin and Southern California combined to avoid disclosure.

resource area, and residue-producing industry, California, 1976

dry weight)

Bark residue					
All bark	Used[1/]				Unused
	Total	Pulp and board	Fuel	Miscellaneous	
580,905	234,358	--	212,826	21,532	346,547
95,252	49,710	--	49,710	--	45,542
561	8	--	--	3	553
676,718	284,076	--	262,536	21,540	392,642
8,583	8,349	--	44	8,305	234
311,963	243,374	--	182,317	61,057	68,589
50,885	38,123	--	28,630	9,493	12,762
362,848	281,497	--	210,947	70,550	81,351
384,262	312,600	--	67,629	244,971	71,662
29,644	28,456	--	8,667	19,789	1;188
413,906	341,056	--	76,296	264,760	72,850
187,041	162,294	--	39,707	122,587	24,747
--	--	--	--	--	--
187,041	162,294	--	39,707	122,587	24,747
--	--	--	--	--	--
1,472,754	960,975	--	502,523	458,452	511,779
175,731	116,289	--	87,007	29,282	59,492
561	8	--	--	3	553
1,649,096	1,077,272	--	589,530	487,742	571,824

Table 11--Number of sawmills by mill-size class, resource area, and county, California, 1976

Resource area and county	All classes	Mill-size class[1]			
		D	C	B	A
North Coast					
Del Norte	6	--	2	4	--
Humboldt	28	--	3	5	20
Mendocino	12	--	--	1	11
Sonoma	6	2	3	--	1
Total	52	2	8	10	32
Central Coast					
Monterey	2	2	--	--	--
Santa Cruz	4	1	2	1	--
Total	6	3	2	1	--
Northern Interior					
Lassen	4	--	1	2	1
Modoc	2	--	1	1	--
Shasta	10	2	1	2	5
Siskiyou	8	1	--	1	6
Trinity	5	--	--	2	3
Total	29	3	3	8	15
Sacramento					
Butte	4	2	--	1	1
El Dorado	5	2	1	--	2
Glenn	1	--	--	1	--
Nevada	5	1	--	3	1
Placer	2	--	--	1	1
Plumas	6	--	2	3	1
Sierra	2	--	1	1	--
Tehama	3	--	--	1	2
Yuba	5	1	2	2	--
Total	33	6	6	13	8
San Joaquin					
Amador	2	--	--	--	2
Calaveras	2	--	1	1	--
Fresno	5	2	1	1	1
Kern	2	1	--	1	--
Madera	3	--	--	2	1
Tulare	3	--	--	1	2
Tuolumne	4	--	1	1	2
Total	21	3	3	7	8
Southern California					
San Bernardino	1	--	1	--	--
All Areas	142	17	23	39	63

---

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

Table 12--Installed 8-hour capacity of sawmills by mill-size class, resource area and county, California, 1976

(Thousand board feet, lumber tally)

Resource area and county	Total capacity	Mill-size class[1]			
		D	C	B	A
North Coast					
Del Norte	495	--	115	380	--
Humboldt	4,015	--	190	490	3,335
Mendocino	1,775	--	--	100	1,675
Sonoma	384	39	160	--	185
Total	6,669	39	465	970	5,195
Central Coast					
Monterey	7	7	--	--	--
Santa Cruz	173	3	90	80	--
Total	180	10	90	80	--
Northern Interior					
Lassen	480	--	70	190	220
Modoc	160	--	60	100	--
Shasta	1,354	39	50	170	1,095
Siskiyou	1,212	30	--	100	1,082
Trinity	560	--	--	185	375
Total	3,766	69	180	745	2,772
Sacramento					
Butte	292	22	--	80	190
El Dorado	502	15	62	--	425
Glenn	100	--	--	100	--
Nevada	490	35	--	305	150
Placer	225	--	--	105	120
Plumas	580	--	110	270	200
Sierra	170	--	70	100	--
Tehama	530	--	--	95	435
Yuba	350	10	150	190	--
Total	3,239	82	392	1,245	1,520
San Joaquin					
Amador	405	--	--	--	405
Calaveras	155	--	55	100	--
Fresno	334	14	75	95	150
Kern	96	1	--	95	--
Madera	285	--	--	160	125
Tulare	430	--	--	105	325
Tuolumne	540	--	70	90	380
Total	2,245	15	200	645	1,385
Southern California					
San Bernardino	75	--	75	--	--
All Areas	16,174	215	1,402	3,685	10,872

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

Table 13--Number of sawmills by mill-size class, resource area, and selected equipment, California, 1976

Resource area and selected equipment	All classes	Mill-size class[1]			
		D	C	B	A
North Coast					
Barker	47	1	5	10	31
Chipper	50	1	7	10	32
Planer	42	2	6	9	25
Burner	33	--	6	6	21
Kiln	21	1	2	3	15
Central Coast					
Barker	2	--	2	--	--
Chipper	1	--	1	--	--
Planer	3	--	2	1	--
Burner	--	--	--	--	--
Kiln	--	--	--	--	--
Northern Interior					
Barker	23	2	--	7	14
Chipper	22	--	1	6	15
Planer	22	2	1	6	13
Burner	15	2	3	5	5
Kiln	17	--	--	5	12
Sacramento					
Barker	26	1	4	13	8
Chipper	26	--	5	13	8
Planer	26	4	3	11	8
Burner	11	1	3	5	2
Kiln	22	1	3	10	8
San Joaquin					
Barker	17	--	3	6	8
Chipper	17	--	3	6	8
Planer	12	1	1	3	7
Burner	5	--	--	3	2
Kiln	12	--	1	4	7
Southern California					
Barker	1	--	1	--	--
Chipper	1	--	1	--	--
Planer	1	--	1	--	--
Burner	--	--	--	--	--
Kiln	1	--	1	--	--
All Areas					
Barker	116	4	15	36	61
Chipper	117	1	18	35	63
Planer	106	9	14	30	53
Burner	64	3	12	19	30
Kiln	73	2	7	22	42

---

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

Table 14--Number of sawmills by selected equipment, resource area, and county, California, 1976

Resource area and county	Barker	Chipper	Planer	Burner	Kiln
North Coast					
Del Norte	5	6	5	4	2
Humboldt	27	28	21	18	11
Mendocino	11	12	10	9	6
Sonoma	4	4	6	2	2
Total	47	50	42	33	21
Central Coast					
Monterey	--	--	--	--	--
Santa Cruz	2	1	3	--	--
Total	2	1	3	--	--
Northern Interior					
Lassen	3	2	3	2	3
Modoc	--	1	2	1	1
Shasta	8	7	8	4	6
Siskiyou	7	7	5	3	4
Trinity	5	5	4	5	3
Total	23	22	22	15	17
Sacramento					
Butte	2	2	4	--	1
El Dorado	3	3	4	1	3
Glenn	1	1	1	1	1
Nevada	5	4	4	2	4
Placer	2	2	2	2	2
Plumas	5	6	4	2	4
Sierra	2	2	1	--	1
Tehama	3	3	3	1	3
Yuba	3	3	3	2	3
Total	26	26	26	11	22
San Joaquin					
Amador	2	2	1	1	1
Calaveras	2	2	1	--	--
Fresno	2	2	1	1	2
Kern	1	1	2	--	1
Madera	3	3	2	2	2
Tulare	3	3	3	1	3
Tuolumne	4	4	2	--	3
Total	17	17	12	5	12
Southern California					
San Bernardino	1	1	1	--	1
All Areas	116	117	106	64	73

Table 15—Number of sawmills by type and size of headrig,[1] resource area,| and mill-size class, California, 1976

Resource area and mill-size class[2]	Circular saw				Band saw				Gang saw			Chipping saw			Scragg double-cut saw		
	2 ft.	4 ft.	6 ft.	8+ ft.	4 ft.	6 ft.	8 ft.	10+ ft.	2 ft.	3 ft.	4 ft.	2 ft.	3 ft.	4 ft.	2 ft.	3 ft.	4 ft.
North Coast																	
D	--	1	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--
C	--	2	2	--	--	1	3	--	--	--	--	--	--	--	--	--	--
B	--	--	--	--	1	4	4	1	--	--	--	--	--	--	--	--	--
A	1	--	1	--	3	16	7	4	--	--	1	--	--	--	--	--	--
Total	1	3	3	--	4	22	14	5	--	--	1	--	--	--	--	--	--
Central Coast																	
D	--	1	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
C	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
B	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--
Total	--	1	4	--	--	1	--	--	--	--	--	--	--	--	--	--	--
Northern Interior																	
D	--	1	1	--	--	1	--	--	--	--	--	--	--	--	--	--	--
C	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--
B	--	--	--	--	--	7	1	--	--	--	--	--	--	--	--	--	--
A	--	--	1	--	1	8	4	1	1	--	--	--	--	--	1	--	--
Total	--	1	2	--	1	16	8	1	1	--	--	--	--	--	1	--	--
Sacramento																	
D	--	2	3	1	--	--	--	--	1	--	--	--	--	--	--	--	--
C	--	--	--	1	1	2	2	--	3	--	--	--	--	--	--	--	--
B	--	--	--	--	2	9	2	--	--	1	--	--	--	--	--	--	--
A	--	--	--	--	--	5	2	--	--	--	1	--	--	--	--	--	--
Total	--	2	3	2	3	16	6	--	4	1	1	--	--	--	--	--	--
San Joaquin																	
D	--	--	2	--	--	1	--	--	--	--	--	--	--	--	--	--	--
C	--	--	--	--	2	1	--	--	--	--	--	1	--	--	--	--	--
B	--	1	2	--	--	3	1	--	2	--	--	--	--	--	--	--	--
A	--	--	1	--	--	1	5	1	--	--	--	--	--	1	--	--	--
Total	--	1	5	--	2	6	6	1	2	--	--	1	--	1	--	--	--
Southern California																	
C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
All Areas																	
D	--	5	8	1	--	3	--	--	1	--	--	--	--	--	--	--	--
C	--	2	4	1	3	5	8	--	3	--	--	1	--	--	--	--	--
B	--	1	2	--	3	24	8	1	2	1	--	--	--	--	--	--	--
A	1	--	3	--	4	30	18	6	1	--	2	--	--	1	1	--	--
Total	--	8	17	2	10	62	34	7	7	1	2	1	--	1	1	--	--

---

[1] Sizes of headrigs are upper limits; the 6-foot size class includes saws 49 through 72 inches.

[2] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

Table 16--Number of sawmills by tenure of present ownership, years at present site, and mill-size class, California, 1976

Mill-size class[1] and years at present site	All mills	Tenure of present mill ownership (years)				
		0-2	3-5	6-10	11-20	21+
D						
0- 2	1	1	--	--	--	--
3- 5	5	--	4	--	--	1
6-10	2	--	--	1	--	1
11-20	6	--	--	1	5	--
21+	3	2	--	--	--	1
Total	17	3	4	2	5	3
C						
0- 2	1	1	--	--	--	--
3- 5	2	1	--	--	--	1
6-10	2	--	--	2	--	--
11-20	4	2	--	--	2	--
21+	14	2	2	--	3	7
Total	23	6	2	2	5	8
B						
0- 2	--	--	--	--	--	--
3- 5	2	--	2	--	--	--
6-10	3	--	--	3	--	--
11-20	9	3	1	2	2	1
21+	25	2	4	9	4	6
Total	39	5	7	14	6	7
A						
0- 2	1	--	--	1	--	--
3- 5	5	--	5	--	--	--
6-10	6	--	1	3	1	1
11-20	16	1	4	7	4	--
21+	35	3	9	3	6	14
Total	63	4	19	14	11	15
All Classes						
0- 2	3	2	--	1	--	--
3- 5	14	1	11	--	--	2
6-10	13	--	1	9	1	2
11-20	35	6	5	10	13	1
21+	77	9	15	12	13	28
Total	142	18	32	32	27	33

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

Table 17--Average number of operating days of sawmills by resource area and mill-size class, California, 1976

Resource area	Average number of operating days per year				
	Mill-size class[1]				Average all classes
	D	C	B	A	
North Coast	229	215	243	246	240
Central Coast	25	170	196	--	102
Northern Interior	167	157	216	238	217
Sacramento	112	134	221	243	191
San Joaquin	72	210	224	241	207
Southern California	--	230	--	--	230
All Areas	113	182	226	243	213

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

Table 18--Wood consumption by sawmills by type of material received, resource area, and mill-size class, California, [illegible]

(Thousand board feet)

Resource area and mill-size class[1]	All wood	Roundwood			Other	
		All roundwood	Sound logs	Utility logs	Peeler cores	Cants
	Local log scale				Lumber tally	
North Coast						
D and C[2]	101,995	97,125	83,901	13,224	1,500	3,370
B	235,009	235,009	195,181	39,828	--	--
A	1,237,119	1,224,119	1,191,546	32,573	13,000	--
Total	1,574,123	1,556,253	1,470,628	85,625	14,500	3,370
Central Coast D, C, and B[2]	23,822	23,822	23,822	--	--	--
Northern Interior						
D	9,106	7,106	6,550	556	2,000	--
C	18,994	18,994	18,644	350	--	--
B	186,683	186,683	182,097	4,586	--	--
A	731,335	731,335	685,010	46,325	--	--
Total	946,118	944,118	892,301	51,817	2,000	--
Sacramento						
D	8,825	8,825	8,045	780	--	--
C	87,366	87,366	87,366	--	--	--
B	403,813	403,813	400,813	3,000	--	--
A	431,315	425,505	415,005	10,500	5,810	--
Total	931,319	925,509	911,229	14,280	5,810	--
San Joaquin						
D	430	430	280	150	--	--
C[3]	62,526	62,526	62,526	--	--	--
B	200,621	200,621	200,121	500	--	--
A	322,187	322,187	318,637	3,550	--	--
Total	585,764	585,764	581,564	4,200	--	--
Southern California C[3]	--	--	--	--	--	--
All Areas						
D	18,361	16,361	14,875	1,486	2,000	--
C	270,881	266,011	252,437	13,574	1,500	3,370
B	1,049,948	1,049,948	1,002,034	47,914	--	--
A	2,721,956	2,703,146	2,610,198	92,948	18,810	--
Total	4,061,146	4,035,466	3,879,544	155,922	22,310	3,370

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

[2] Combined to avoid disclosure.

[3] San Joaquin and Southern California combined to avoid disclosure.

Table 19--Log consumption by sawmills by timber age group, resource area, and mill-size class, California, 1976

(Thousand board feet, local scale)

Resource area and mill-size class[1]	All age groups	Old growth (100+ years)	Young growth (less than 100 years)
North Coast			
D and C[2]	97,125	47,618	49,507
B	235,009	195,489	39,520
A	1,224,119	720,118	504,001
Total	1,556,253	963,225	593,028
Central Coast			
D, C, and B[2]	23,822	2,184	21,638
Northern Interior			
D	7,106	3,679	3,427
C	18,994	11,584	7,410
B	186,683	162,536	24,147
A	731,335	580,224	151,111
Total	944,118	758,023	186,095
Sacramento			
D	8,825	7,503	1,322
C	87,366	56,279	31,087
B	403,813	284,283	119,530
A	425,505	334,682	90,823
Total	925,509	682,747	242,762
San Joaquin			
D	430	321	109
C[3]	62,526	20,457	42,069
B	200,621	137,349	63,272
A	322,187	250,801	71,386
Total	585,764	408,928	176,836
Southern California			
C[3]	--	--	--
All Areas			
D	16,361	11,503	4,858
C	266,011	135,938	130,073
B	1,049,948	781,841	268,107
A	2,703,146	1,885,825	817,321
Total	4,035,466	2,815,107	1,220,359

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

[2] Combined to avoid disclosure.

[3] San Joaquin and Southern California combined to avoid disclosure.

Table 20--Log consumption by sawmills by timber age group, resource area, and county, California, 1976

(Thousand board feet, local scale)

Resource area and county	All age groups	Old growth (100+ years)	Young growth (less than 100 years)
North Coast			
Del Norte	143,526	111,765	31,761
Humboldt	920,718	687,539	233,179
Mendocino	395,320	140,241	255,079
Sonoma	96,689	23,680	73,009
Total	1,556,253	963,225	593,028
Central Coast			
Monterey and Santa Cruz[1]	23,822	2,184	21,638
Northern Interior			
Lassen and Modoc[1]	167,434	156,087	11,347
Shasta	320,708	211,841	108,867
Siskiyou	312,656	259,455	53,201
Trinity	143,320	130,640	12,680
Total	944,118	758,023	186,095
Sacramento			
Butte	88,453	40,264	48,189
El Dorado	117,905	69,485	48,420
Glenn and Tehama[1]	208,417	145,521	62,896
Placer and Nevada[1]	197,140	160,857	36,283
Plumas and Sierra[1]	208,634	184,581	24,053
Yuba	104,960	82,039	22,921
Total	925,509	682,747	242,762
San Joaquin			
Calaveras and Amador[1]	130,354	63,142	67,212
Fresno and Madera[1]	180,639	138,121	42,518
Tulare and Kern[2]	145,781	133,839	11,942
Tuolumne	128,990	73,826	55,164
Total	585,764	408,928	176,836
Southern California			
San Bernardino[2]	--	--	--
All Areas	4,035,466	2,815,107	1,220,359

[1] Combined to avoid disclosure.

[2] Tulare, Kern, and San Bernardino combined to avoid disclosure.

Table 21--Log inventory changes, log consumption, and apparent log receipts by sawmills by resource area, California, 1976

(Thousand board feet, local scale)

Resource area	Log inventory			1976 log consumption	Apparent 1976 log receipts
	January 1, 1976	December 31, 1976	Net change		
North Coast	426,574	477,194	50,620	1,556,253	1,606,873
Central Coast	3,183	3,489	306	23,822	24,128
Northern Interior	348,343	397,222	48,879	944,118	992,997
Sacramento	246,931	336,025	89,094	925,509	1,014,603
San Joaquin and Southern California[1/]	177,932	202,567	24,635	535,764	610,399
All Areas	1,202,963	1,416,497	213,534	4,035,466	4,249,000

[1/] San Joaquin and Southern California combined to avoid disclosure.

Table 22—Log consumption by sawmills by ownership class, resource area, and mill-size class, California, 1976

(Thousand board feet, local scale)

Resource area and mill-size class[1]	All owners	State	National Forest	Bureau of Land Management	Other public	Forest industry: Own wood supply	Forest industry: Other wood supply	Farmer and miscellaneous private
North Coast								
D and C[2]	97,125	--	18,525	400	--	37,584	15,908	24,708
B	235,009	--	22,206	--	--	94,913	111,120	6,770
A	1,224,119	37,501	158,647	--	18,782	670,018	113,278	225,893
Total	1,556,253	37,501	199,378	400	18,782	802,515	240,306	257,371
Central Coast								
D, C, and B[2]	23,822	--	--	--	--	--	3,623	20,199
Northern Interior								
D	7,106	--	3,000	1,000	--	106	--	3,000
C	18,994	--	12,696	--	--	--	1,288	5,010
B	186,683	--	139,424	--	--	3,302	25,076	18,881
A	731,335	8,630	335,615	2,350	--	218,668	123,399	42,673
Total	944,118	8,630	490,735	3,350	--	222,076	149,763	69,564
Sacramento								
D	8,825	--	3,797	--	--	600	32	4,396
C	87,366	--	41,495	--	--	4,000	2,148	39,723
B	403,813	--	218,283	--	--	98,160	18,014	69,356
A	425,505	798	154,196	--	--	180,898	53,222	36,391
Total	925,509	798	417,771	--	--	283,658	73,416	149,866
San Joaquin								
D	430	--	357	--	--	--	--	73
C[3]	62,526	--	46,401	--	--	3,250	-	12,875
B	200,621	--	190,196	2,100	--	3,025	2,100	3,200
A	322,187	831	221,410	--	--	47,967	15,500	36,479
Total	585,764	831	458,364	2,100	--	54,242	17,600	52,627
Southern California								
C[3]	--	--	--	--	--	--	--	--
All Areas								
D	16,361	--	7,154	1,000	--	706	32	7,469
C	266,011	--	119,117	400	--	44,834	19,344	82,316
B	1,049,948	--	570,109	2,100	--	199,400	159,933	118,406
A	2,703,146	47,760	869,868	2,350	18,782	1,117,551	305,399	341,436
Total	4,035,466	47,760	1,566,248	5,850	18,782	1,362,491	484,708	549,627

---

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

[2] Combined to avoid disclosure.

[3] San Joaquin and Southern California combined to avoid disclosure.

Table 23—Log consumption by sawmills by ownership class, resource area, and county, California, 1976

(Thousand board feet, local scale)

Resource area and county	All owners	State	National Forest	Bureau of Land Management	Other public	Forest industry		Farmer and miscellaneous private
						Own wood supply	Other wood supply	
North Coast								
Del Norte	143,526	--	21,163	--	--	86,249	30,429	5,685
Humboldt	920,718	--	144,583	400	18,025	481,138	172,725	103,847
Mendocino	395,320	37,501	33,632	--	757	187,838	33,052	102,540
Sonoma	96,689	--	--	--	--	47,290	4,100	45,299
Total	1,556,253	37,501	199,378	400	18,782	802,515	240,306	257,371
Central Coast								
Monterey and Santa Cruz1/	23,822	--	--	--	--	--	3,623	20,199
Northern Interior								
Lassen and Modoc1/	167,434	--	157,765	--	--	--	3,900	5,769
Shasta	320,708	8,630	114,923	1,000	--	83,405	61,968	50,782
Siskiyou	312,656	--	105,765	--	--	135,589	66,589	4,713
Trinity	143,320	--	112,282	2,350	--	3,082	17,306	8,300
Total	944,118	8,630	490,735	3,350	--	222,076	149,763	69,564
Sacramento								
Butte	88,453	--	20,880	--	--	4,275	44,004	19,294
El Dorado	117,905	--	34,964	--	--	65,326	--	17,615
Glenn and Tehama1/	208,417	798	89,629	--	--	98,625	3,193	16,172
Placer and Nevada1/	197,140	--	95,450	--	--	64,011	17,266	20,413
Plumas and Sierra1/	208,634	--	120,222	--	--	51,421	8,953	28,038
Yuba	104,960	--	56,626	--	--	--	--	48,334
Total	925,509	798	417,771	--	--	283,658	73,416	149,866
San Joaquin								
Calaveras and Amador1/	130,354	--	63,802	2,100	--	31,352	17,600	15,500
Fresno and Madera1/	180,639	--	166,606	--	--	3,025	--	11,008
Tulare and Kern2/	145,781	831	138,085	--	--	1,217	--	5,648
Tuolumne	128,990	--	89,871	--	--	18,648	--	20,471
Total	585,764	831	458,364	2,100	--	54,242	17,600	52,627
Southern California								
San Bernardino2/	--	--	--	--	--	--	--	--
All Areas	4,035,466	47,760	1,566,248	5,850	18,782	1,362,491	484,708	549,627

1/ Combined to avoid disclosure.

2/ Tulare, Kern, and San Bernardino combined to avoid disclosure.

Table 24—Dependency of sawmills for logs by ownership

(Number

Resource area and mill-size class[1]	National Forest				State				Bureau of Land Management			
	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100
North Coast												
D	2	--	--	--	2	--	--	--	2	--	--	--
C	6	--	1	1	8	--	--	--	7	1	--	--
B	7	2	1	--	10	--	--	--	10	--	--	--
A	19	7	2	4	26	5	1	--	32	--	--	--
Total	34	9	4	5	46	5	1	--	51	1	--	--
Central Coast												
D	3	--	--	--	3	--	--	--	3	--	--	--
C	2	--	--	--	2	--	--	--	2	--	--	--
B	1	--	--	--	1	--	--	--	1	--	--	--
Total	6	--	--	--	6	--	--	--	6	--	--	--
Northern Interior												
D	2	--	--	1	3	--	--	--	2	1	--	--
C	1	--	--	2	3	--	--	--	3	--	--	--
B	--	1	2	5	8	--	--	--	8	--	--	--
A	1	6	2	6	13	2	--	--	14	1	--	--
Total	4	7	4	14	27	2	--	--	27	2	--	--
Sacramento												
D	4	--	1	1	6	--	--	--	6	--	--	--
C	--	1	3	2	6	--	--	--	6	--	--	--
B	--	2	6	5	13	--	--	--	13	--	--	--
A	--	3	5	--	7	1	--	--	8	--	--	--
Total	4	6	15	8	32	1	--	--	33	--	--	--
San Joaquin												
D	--	1	--	2	3	--	--	--	3	--	--	--
C	--	1	--	2	3	--	--	--	3	--	--	--
B	--	--	--	7	7	--	--	--	6	1	--	--
A	1	--	1	6	7	1	--	--	8	--	--	--
Total	1	2	1	17	20	1	--	--	20	1	--	--
Southern California												
C	--	--	--	1	1	--	--	--	1	--	--	--
All Areas												
D	11	1	1	4	17	--	--	--	16	1	--	--
C	9	2	4	8	23	--	--	--	22	1	--	--
B	8	5	9	17	39	--	--	--	38	1	--	--
A	21	16	10	16	53	9	1	--	62	1	--	--
Total	49	24	24	45	132	9	1	--	138	4	--	--

---

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

rigin, resource area, and mill-size class, California, 1976

f mills)

Other public				Forest industry								Farmer and miscellaneous private			
				Own wood supply				Other wood supply							
Dependency (percent)															
0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100
2	--	--	--	1	--	1	--	1	--	1	--	1	--	--	1
8	--	--	--	5	1	2	--	4	1	1	2	1	4	--	3
10	--	--	--	5	1	1	3	2	1	3	4	7	2	1	--
30	1	--	1	9	7	4	12	20	9	1	2	17	5	8	2
50	1	--	1	20	9	8	15	27	11	6	8	26	11	9	6
3	--	--	--	3	--	--	--	3	--	--	--	--	--	--	[illegible]
2	--	--	--	2	--	--	--	2	--	--	--	--	--	--	[illegible]
1	--	--	--	1	--	--	--	--	1	--	--	--	--	--	1
6	--	--	--	6	--	--	--	5	1	--	--	--	--	--	6
3	--	--	--	2	--	--	1	3	--	--	--	2	--	--	1
3	--	--	--	3	--	--	--	2	1	--	--	1	1	--	1
8	--	--	--	6	2	--	--	5	2	1	--	4	3	1	--
15	--	--	--	9	1	4	1	5	7	3	--	6	8	1	--
29	--	--	--	20	3	4	2	15	10	4	--	13	12	2	2
6	--	--	--	5	--	--	1	5	1	--	--	1	1	1	[illegible]
6	--	--	--	5	1	--	--	4	2	--	--	1	2	2	1
13	--	--	--	5	4	4	--	9	4	--	--	5	6	1	1
8	--	--	--	1	2	4	1	4	3	--	1	3	4	--	1
33	--	--	--	16	7	8	2	22	10	--	1	10	13	4	[illegible]
3	--	--	--	3	--	--	--	3	--	--	--	2	--	--	1
3	--	--	--	2	1	--	--	3	--	--	--	1	1	--	1
7	--	--	--	5	2	--	--	6	1	--	--	5	2	--	--
8	--	--	--	4	3	1	--	7	--	1	--	1	6	1	--
21	--	--	--	14	6	1	--	19	1	1	--	9	9	1	2
1	--	--	--	1	--	--	--	1	--	--	--	1	--	--	--
17	--	--	--	14	--	1	2	15	1	1	--	6	1	1	[illegible]
23	--	--	--	18	3	2	--	16	4	1	2	5	[illegible]	[illegible]	[illegible]
39	--	--	--	22	9	5	3	22	9	4	4	21	13	[illegible]	[illegible]
61	1	--	1	23	13	13	14	36	19	5	3	27	23	[illegible]	[illegible]
140	1	--	1	77	25	21	19	89	33	11	9	59	45	16	[illegible]

Table 25—Log consumption by sawmills by species, resource area, and mill-size class, California, 1976

(Thousand board feet, local scale)

Resource area and mill-size class 1/	All species	Douglas-fir	Hemlock	True firs	Redwood	Ponderosa pine	Sugar pine	Incense-cedar	Other softwoods	Hardwoods
North Coast										
D and C 2/	97,125	47,051	3,445	1,315	38,051	1,374	--	285	4,301	1,303
B	235,009	83,237	6,362	15,495	113,295	14,811	--	958	551	300
A	1,224,119	417,811	4,115	27,451	711,101	38,939	3,668	3,262	17,772	--
Total	1,556,253	548,099	13,922	44,261	862,447	55,124	3,668	4,505	22,624	1,603
Central Coast D, C, and B 2/	23,822	3,757	--	--	19,965	--	--	--	50	50
Northern Interior										
D	7,106	2,850	--	149	--	91	--	16	--	4,000
C	18,994	1,030	--	1,937	--	13,544	515	1,556	--	412
B	186,683	28,645	--	20,426	--	95,190	5,921	36,348	153	--
A	731,335	181,784	3,409	175,615	--	263,649	49,804	39,630	16,012	1,432
Total	944,118	214,309	3,409	198,127	--	372,474	56,240	77,550	16,165	5,844
Sacramento										
D	8,825	2,167	--	208	--	332	--	5,977	81	60
C	87,366	22,560	--	31,273	--	25,610	325	5,668	1,930	--
B	403,813	63,600	--	130,189	--	159,242	12,222	27,188	11,372	--
A	425,505	59,890	--	153,132	--	124,930	51,319	6,121	30,113	--
Total	925,509	148,217	--	314,802	--	310,114	63,866	44,954	43,496	60
San Joaquin										
D	430	--	--	105	--	3	--	268	2	52
C 3/	62,526	390	--	26,924	--	27,467	1,084	5,751	910	--
B	200,621	3,100	--	94,510	--	69,508	16,238	13,262	4,003	--
A	322,187	5,790	--	104,827	--	126,974	36,966	46,949	681	--
Total	585,764	9,280	--	226,366	--	223,952	54,288	66,230	5,596	52
Southern California C 3/	--	--	--	--	--	--	--	--	--	--
All Areas										
D	16,361	5,017	--	462	--	426	--	6,261	83	4,112
C	266,011	71,031	3,445	61,449	38,051	67,995	1,924	13,260	7,141	1,715
B	1,049,948	182,339	6,362	260,620	133,260	338,751	34,381	77,756	16,129	350
A	2,703,146	665,275	7,524	461,025	711,101	554,492	141,757	95,962	64,578	1,432
Total	4,035,466	923,662	17,331	783,556	882,412	961,664	178,062	193,239	87,931	7,609

1/ Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

2/ Combined to avoid disclosure.

3/ San Joaquin and Southern California combined to avoid disclosure.

Table 26—Log consumption by sawmills by species, resource area, and type of material, California, 1976

(Thousand board feet, local scale)

Resource area and type of material	All species	Douglas-fir	Hemlock	True firs	Redwood	Ponderosa pine	Sugar pine	Incense-cedar	Other softwoods	Hardwoods
North Coast										
Sound	1,470,627	509,277	13,372	37,350	824,059	54,815	3,608	4,505	22,038	1,603
Utility	85,626	[illegible]	550	6,911	38,388	309	60	--	586	--
Total	1,556,253	[illegible]	13,922	44,261	862,447	55,124	3,668	4,505	22,624	1,603
Central Coast										
Sound	23,822	3,757	--	--	19,965	--	--	--	50	50
Utility	--	--	--	--	--	--	--	--	--	--
Total	23,822	3,757	--	--	19,965	--	--	--	50	50
Northern Interior										
Sound	782,301	[illegible]	[illegible]	[illegible]	--	363,872	55,486	72,319	15,230	5,632
Utility	61,817	[illegible]	--	[illegible]	--	8,602	754	5,231	935	12
Total	844,118	[illegible]	[illegible]	[illegible]	--	372,474	56,240	77,550	16,165	5,644
Sacramento										
Sound	[illegible]	[illegible]	--	[illegible]	--	306,206	[illegible]	43,784	42,821	60
Utility	[illegible]	[illegible]	--	[illegible]	--	3,908	[illegible]	1,170	675	--
Total	[illegible]	[illegible]	--	[illegible]	--	310,114	[illegible]	44,954	43,496	60
San Joaquin										
Sound	[illegible]	[illegible]	--	[illegible]	--	223,516	[illegible]	65,877	5,596	50
Utility	[illegible]	[illegible]	--	[illegible]	--	436	170	353	--	--
Total	[illegible]	[illegible]	--	[illegible]	--	223,952	[illegible]	66,230	5,596	50
Southern California										
[illegible][1]	--	--	--	--	--	--	--	--	--	--
All areas										
Sound	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	948,409	[illegible]	186,485	85,735	7,395
Utility	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13,255	[illegible]	6,754	2,196	12
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	961,664	[illegible]	193,239	87,931	7,407

[1] [illegible]

Table 27—Log consumption by sawmills by species, resource area, and county, California, 1976

(Thousand board feet, local scale)

Resource area and county	All species	Douglas-fir	Hemlock	True firs	Redwood	Ponderosa pine	Sugar pine	Incense-cedar	Other softwoods	Hardwoods
North Coast										
Del Norte	143,526	49,139	3,786	12,205	76,021	--	--	--	2,375	--
Humboldt	920,718	358,773	6,741	20,449	511,136	15,772	780	3,055	3,712	300
Mendocino	395,320	98,266	3,395	9,203	225,674	38,192	2,888	1,165	16,537	--
Sonoma	96,689	41,921	--	2,404	49,616	1,160	--	285	--	1,303
Total	1,556,253	548,099	13,922	44,261	862,447	55,124	3,668	4,505	22,624	1,603
Central Coast										
Monterey and Santa Cruz[1]	23,822	3,757	--	--	19,965	--	--	--	50	50
Northern Interior										
Lassen and Modoc[1]	167,434	1,805	--	37,511	--	122,192	4,679	1,247	--	--
Shasta	320,708	50,714	3,409	77,146	--	104,737	23,481	44,571	11,155	5,495
Siskiyou	312,656	85,583	--	68,439	--	108,533	15,998	28,897	4,857	349
Trinity	143,320	76,207	--	15,031	--	37,012	12,082	2,835	153	--
Total	944,118	214,309	3,409	198,127	--	372,474	56,240	77,550	16,165	5,844
Sacramento										
Butte	88,453	9,432	--	52,265	--	15,293	--	9,063	2,400	--
El Dorado	117,905	7,217	--	37,035	--	50,037	19,800	3,735	81	--
Glenn and Tehama[1]	208,417	46,027	--	35,287	--	87,025	10,483	1,920	27,675	--
Placer and Nevada[1]	197,140	25,655	--	74,327	--	67,376	14,681	12,663	2,438	--
Plumas and Sierra[1]	208,634	32,592	--	94,915	--	56,599	18,577	5,791	160	--
Yuba	104,960	27,294	--	20,973	--	33,784	325	11,782	10,742	60
Total	925,509	148,217	--	314,802	--	310,114	63,866	44,954	43,496	60
San Joaquin										
Calaveras and Amador[1]	130,354	6,411	--	22,349	--	50,742	16,992	32,950	910	--
Fresno and Madera[1]	180,639	454	--	83,686	--	52,530	28,115	11,118	4,684	52
Tulare and Kern[2]	145,781	--	--	98,020	--	29,696	8,097	9,966	2	--
Tuolumne	128,990	2,415	--	22,311	--	90,984	1,084	12,196	--	--
Total	585,764	9,280	--	226,366	--	223,952	54,288	66,230	5,596	52
Southern California										
San Bernardino[2]	--	--	--	--	--	-	--	--	--	--
All Areas	4,035,466	923,662	17,331	783,556	882,412	961,664	178,062	193,239	87,931	7,609

---

[1] Combined to avoid disclosure.

[2] Tulare, Kern, and San Bernardino combined to avoid disclosure.

Table 28—Production and disposition of wood and bark residues by sawmills by resource area and mill-size class, California, 1976

(Tons, dry weight)

Resource area and mill-size class[1]	All residues			Wood residue			Bark residue		
	Total	Used[2]	Unused	Total	Used	Unused	Total	Used	Unused
North Coast									
D and C[3]	139,466	103,241	36,225	106,655	96,029	[illegible]	32,811	7,212	25,599
B	351,577	252,124	99,453	271,226	224,063	[illegible]	80,351	28,061	52,290
A	2,104,203	1,609,519	494,684	1,636,460	1,410,434	[illegible]	467,743	199,085	268,658
Total	2,595,246	1,964,884	630,362	2,014,341	1,730,526	[illegible]	580,905	234,358	346,547
Central Coast									
D, C, and B[3]	37,401	37,167	234	28,818	28,818	--	8,583	8,349	234
Northern Interior									
D	12,709	2,544	10,165	9,579	2,525	7,054	3,130	19	3,111
C	23,318	2,693	20,625	17,507	2,693	14,814	5,811	--	5,811
B	270,668	208,887	61,781	210,018	170,823	39,195	60,650	38,064	22,586
A	1,087,551	974,822	112,729	845,179	769,531	75,648	242,372	205,291	37,081
Total	1,394,246	1,188,946	205,300	1,082,283	945,572	136,711	311,963	[illegible]	68,589
Sacramento									
D	11,940	8,555	3,385	9,251	6,044	3,207	2,689	2,511	178
C	130,123	88,433	41,690	101,845	83,076	18,769	28,278	5,357	22,921
B	581,087	502,552	78,535	448,847	391,953	56,894	[illegible]	110,599	21,641
A	1,013,864	951,835	62,029	792,809	757,702	35,107	221,055	194,133	26,922
Total	1,737,014	1,551,375	185,639	1,352,752	1,238,775	113,977	384,262	312,600	71,662
San Joaquin									
D	384	360	24	287	278	[illegible]	97	82	15
C[4]	74,837	74,837	--	56,780	56,780	-	18,057	18,057	[illegible]
B	250,506	206,787	43,719	[illegible]	162,230	26,162	62,114	44,557	17,557
A	459,790	392,310	67,480	353,017	292,712	60,305	106,773	[illegible]	7,175
Total	785,517	674,294	111,223	598,476	512,000	86,476	187,041	162,294	24,747
Southern California									
C[4]	--	--	--	--	--	--	--	--	
All Areas									
D	25,033	11,459	13,574	19,117	8,847	10,270	5,916	2,612	3,304
C	367,744	269,204	98,540	282,787	238,578	44,209	84,957	30,626	54,331
B	1,491,239	1,207,517	283,722	1,147,301	977,887	169,414	343,938	229,630	114,308
A	4,665,408	3,928,486	736,922	3,627,465	3,230,379	397,086	1,037,943	698,107	339,836
Total	6,549,424	5,416,666	1,132,758	5,076,670	4,455,691	620,979	1,472,754	960,975	511,779

---

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B [illegible]

[2] Residues are not necessarily consumed in the economic area in which they were produced.

[3] Combined to avoid disclosure.

[4] San Joaquin and Southern California combined to avoid disclosure.

Table 29—Production and disposition of wood residues by sawmills

(Tons, dry

Resource area and mill-size class[1]	All types						
	Total	Total used[2]	Pulp	Board	Fuel	Other	Unused
North Coast							
D and C[4]	106,655	96,029	64,012	6,266	12,185	13,566	10,626
B	271,226	224,063	145,350	13,318	61,558	3,837	47,163
A	1,636,460	1,410,434	683,510	271,085	292,908	162,931	226,026
Total	2,014,341	1,730,526	892,872	290,669	366,651	180,334	283,815
Central Coast							
D, C, and B[4]	28,818	28,818	—	--	158	28,660	--
Northern Interior							
D	9,579	2,525	--	2,459	66	--	7,054
C	17,507	2,693	1,364	1,329	--	--	14,814
B	210,018	170,823	73,925	18,349	78,388	161	39,195
A	845,179	769,531	398,293	12,094	359,144	--	75,648
Total	1,082,283	945,572	473,582	34,231	437,598	161	136,711
Sacramento							
D	9,251	6,044	5,274	--	73	697	3,207
C	101,845	83,076	41,461	4,241	24,585	12,789	18,769
B	448,847	391,953	172,429	5,622	177,673	36,229	56,894
A	792,809	757,702	355,873	137,640	238,164	26,025	35,107
Total	1,352,752	1,238,775	575,037	147,503	440,495	75,740	113,977
San Joaquin							
D	287	278	--	--	197	81	9
C[5]	56,780	56,780	18,635	20,961	3,739	13,445	--
B	188,392	162,230	86,314	35,864	23,807	16,245	26,162
A	353,017	292,712	154,988	60,810	48,202	28,712	60,305
Total	598,476	512,000	259,937	117,635	75,945	58,483	86,476
Southern California							
C[5]	--	--	--	—	--	--	--
All Areas							
D	19,117	8,847	5,274	2,459	336	778	10,270
C	282,787	238,578	125,472	32,797	40,509	39,800	44,209
B	1,147,301	977,887	478,018	73,153	341,584	85,132	169,414
A	3,627,465	3,230,379	1,592,664	481,629	938,418	217,668	397,086
Total	5,076,670	4,455,691	2,201,428	590,038	1,320,847	343,378	620,979

See footnotes at end of table.

by type of residue, resource area, and mill-size class, California, 1976

weight)

Coarse[3]						
Total	Total used[2]	Pulp	Board	Fuel	Other	Unused
67,397	64,370	49,692	4,393	6,266	4,019	3,027
171,729	158,672	145,350	--	13,322	--	13,057
1,029,150	955,054	668,623	125,425	49,987	111,019	74,096
1,268,276	1,178,096	863,665	129,818	69,575	115,038	90,180
19,684	19,684	--	--	121	19,563	--
5,726	2,339	--	2,304	35	--	3,387
10,819	1,364	1,364	--	--	--	9,455
121,230	109,844	73,372	--	36,472	--	11,386
467,645	434,618	390,617	--	44,001	--	33,027
605,420	548,165	465,353	2,304	80,508	--	57,255
5,915	5,864	5,274	--	72	518	51
54,339	50,136	41,461	--	--	8,675	4,203
254,399	242,736	172,429	--	51,180	19,127	11,663
427,174	427,174	355,873	40,722	8,825	21,754	--
741,827	725,910	575,037	40,722	60,077	50,074	15,917
204	197	--	--	197	--	7
33,556	33,556	18,635	9,361	--	5,560	--
114,886	99,282	86,314	12,968	--	--	15,604
208,791	190,255	154,988	22,184	12,475	608	18,536
357,437	323,290	259,937	44,513	12,672	6,168	34,147
--	--	--	--	--	--	--
11,845	8,400	5,274	2,304	304	518	3,445
166,111	149,426	111,152	13,754	6,266	18,254	16,685
681,928	630,218	477,465	12,968	101,095	38,690	51,710
2,132,760	2,007,101	1,570,101	188,331	115,288	133,381	125,659
2,992,644	2,795,145	2,163,992	217,357	222,953	190,843	197,499

Table 29—Production and disposition of wood residues by sawmills

(Tons, dry

Resource area and mill-size class[1]	Shavings						
	Total	Total used[2]	Pulp	Board	Fuel	Other	Unused
North Coast							
D and C[4]	10,005	8,828	2,102	515	2,231	3,980	1,177
B	30,342	26,350	--	13,318	11,085	1,947	3,992
A	202,076	184,083	--	105,861	59,300	18,922	17,993
Total	242,423	219,261	2,102	119,694	72,616	24,849	23,162
Central Coast							
D, C, and B[4]	2,408	2,408	--	--	--	2,408	--
Northern Interior							
D	789	168	--	155	13	--	621
C	1,110	1,110	--	1,110	--	--	--
B	32,294	26,457	553	18,349	7,555	--	5,837
A	143,076	140,234	7,676	12,094	120,464	--	2,842
Total	177,269	167,969	8,229	31,708	128,032	--	9,300
Sacramento							
D	1,111	31	--	--	1	30	1,080
C	20,179	19,959	--	4,241	12,795	2,923	220
B	65,947	64,906	--	5,622	44,209	15,075	1,041
A	150,584	147,694	--	96,918	46,505	4,271	2,890
Total	237,821	232,590	--	106,781	103,510	22,299	5,231
San Joaquin							
D	1	1	--	--	--	1	--
C[5]	5,689	5,689	--	3,679	--	2,010	--
B	18,383	18,383	--	9,643	6,374	2,366	--
A	43,813	42,884	--	24,676	--	18,208	929
Total	67,886	66,957	--	37,998	6,374	22,585	929
Southern California							
C[5]	--	--	--	--	--	--	--
All Areas							
D	1,901	200	--	155	14	31	1,701
C	36,983	35,586	2,102	9,545	15,026	8,913	1,397
B	149,374	138,504	553	46,932	69,223	21,796	10,870
A	539,549	514,895	7,676	239,549	226,269	41,401	24,654
Total	727,807	689,185	10,331	296,181	310,532	72,141	38,622

---

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

[2] Not necessarily used in the economic area in which produced.

[3] Slabs, edgings, trim, and spur ends.

[4] Combined to avoid disclosure.

[5] San Joaquin and Southern California combined to avoid disclosure.

by type of residue, resource area, and mill-size class, California, 1976 —Continued

weight)

Sawdust						
Total	Total used2/	Pulp	Board	Fuel	Other	Unused
29,253	22,831	12,218	1,358	3,688	5,567	6,422
69,155	39,041	--	--	37,151	1,890	30,114
405,234	271,297	14,887	39,779	183,621	32,990	133,937
503,642	333,169	27,105	41,157	224,460	40,447	170,473
6,726	6,726	--	--	37	6,689	--
3,064	18	--	--	18	--	3,046
5,578	219	—	219	--	--	5,359
56,494	34,522	--	--	34,351	161	21,972
234,458	194,679	--	—	194,679	—	39,779
299,594	229,438	--	219	229,058	161	70,156
2,225	149	--	--	--	149	2,076
27,327	12,981	--	—	11,790	1,191	14,346
128,501	84,311	--	--	82,284	2,027	44,190
215,051	182,834	--	—	182,834	--	32,217
373,104	280,275	--	--	276,908	3,367	92,829
82	80	--	--	--	80	2
17,535	17,535	--	7,921	3,739	5,875	--
55,123	44,565	--	13,253	17,433	13,879	10,558
100,413	59,573	--	13,950	35,727	9,896	40,840
173,153	121,753	--	35,124	56,899	29,730	51,400
--	--	--	--	--	--	--
5,371	247	--	--	18	229	5,124
79,693	53,566	12,218	9,498	19,217	12,633	26,127
315,999	209,165	--	13,253	171,266	24,646	106,834
955,156	708,383	14,887	53,749	596,861	42,886	246,773
1,356,219	971,361	27,105	76,500	787,362	80,394	384,858

Table 30—Production and disposition of bark residues by sawmills by use, resource area, and mill-size class, California, 1976

(Tons, dry weight)

Resource area and mill-size class[1]	All bark	Used[2]					Unused
		Total	Pulp	Board	Fuel	Miscellaneous	
North Coast							
D and C[3]	32,811	7,212	--	--	2,306	4,906	25,599
B	80,351	28,061	--	--	24,590	3,471	52,290
A	467,743	199,085	--	--	185,930	13,155	268,658
Total	580,905	234,358	--	--	212,826	21,532	346,547
Central Coast							
D, C, and B[3]	8,583	8,349	--	--	44	8,305	234
Northern Interior							
D	3,130	19	--	--	19	--	3,111
C	5,811	--	--	--	--	--	5,811
B	60,650	38,064	--	--	37,898	166	22,586
A	242,372	205,291	--	--	144,400	60,891	37,081
Total	311,963	243,374	--	--	182,317	61,057	68,589
Sacramento							
D	2,689	2,511	--	--	--	2,511	178
C	28,278	5,357	--	--	1,368	3,989	22,921
B	132,240	110,599	--	--	33,045	77,554	21,641
A	221,055	194,133	--	--	33,216	160,917	26,922
Total	384,262	312,600	--	--	67,629	244,971	71,662
San Joaquin							
D	97	82	--	--	82	--	15
C[4]	18,057	18,057	--	--	6,070	11,987	--
B	62,114	44,557	--	--	--	44,557	17,557
A	106,773	99,598	--	--	33,555	66,043	7,175
Total	187,041	162,294	--	--	39,707	122,587	24,747
Southern California							
C[4]	--	--	--	--	--	--	--
All Areas							
D	5,916	2,612	--	--	101	2,511	3,304
C	84,957	30,626	--	--	9,744	20,882	54,331
B	343,938	229,630	--	--	95,577	134,053	114,308
A	103,943	698,107	--	--	397,101	301,006	339,836
Total	1,472,754	960,975	--	--	502,523	458,452	511,779

---

[1] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

[2] Not necessarily used in the resource area in which produced.

[3] Combined to avoid disclosure.

[4] San Joaquin and Southern California combined to avoid disclosure.

56%

Table 31—Production and disposition of wood and bark residues by sawmills by resource area and county, California, 1976

(Tons, dry weight)

Resource area and county	All residues			Wood residue			Bark residue		
	Total	Used1/	Unused	Total	Used1/	Unused	Total	Used1/	Unused
North Coast									
Del Norte	197,643	141,712	55,931	151,277	133,905	17,372	46,366	7,807	38,559
Humboldt	1,511,918	1,188,659	323,259	1,167,669	1,015,648	152,021	344,249	173,011	171,238
Mendocino	705,124	484,264	220,860	554,777	447,900	106,877	150,347	36,364	113,983
Sonoma	180,561	150,249	30,312	140,618	133,073	7,545	39,943	17,176	22,767
Total	2,595,246	1,964,884	630,362	2,014,341	1,730,526	283,815	580,905	234,358	346,547
Central Coast									
Monterey and Santa Cruz2/	37,401	37,167	234	28,818	28,818	--	8,583	8,349	234
Northern Interior									
Lassen and Modoc1/	245,099	204,115	40,984	191,377	160,416	30,961	53,722	43,699	10,023
Shasta	478,662	392,484	96,178	371,893	299,320	72,573	106,769	93,164	23,605
Siskiyou	440,783	432,329	8,454	341,490	335,601	5,889	99,293	96,728	2,565
Trinity	229,702	170,018	59,684	177,523	150,235	27,288	52,179	19,783	32,396
Total	1,394,246	1,188,946	205,300	1,082,283	945,572	136,711	311,963	243,374	68,589
Sacramento									
Butte	155,595	129,777	25,818	120,686	94,868	25,818	34,909	34,909	--
El Dorado	560,643	549,935	10,708	440,258	440,112	146	120,385	109,823	10,562
Glenn and Tehama	287,546	270,482	17,064	224,373	216,561	7,812	63,173	53,921	9,252
Placer and Nevada	265,665	220,829	44,836	204,778	169,199	35,579	60,887	51,630	9,257
Plumas and Sierra	305,946	265,203	40,743	236,784	214,464	22,320	69,162	50,739	18,423
Yuba	161,619	115,149	46,470	125,873	103,571	22,302	35,746	11,578	24,168
Total	1,737,014	1,551,375	185,639	1,352,752	1,238,775	113,977	384,262	312,600	71,662
San Joaquin									
Calaveras and Amador3/	173,862	135,995	37,867	133,093	101,076	32,017	40,769	34,919	5,850
Fresno and Madera3/	216,925	173,206	43,719	161,735	135,573	26,162	55,190	37,633	17,557
Tulare and Kern3/	223,144	193,507	29,637	174,039	145,742	28,297	49,105	47,765	1,340
Tuolumne	171,586	171,586	--	129,609	129,609	--	41,977	41,977	--
Total	785,517	674,294	111,223	598,476	512,000	86,476	187,041	162,294	24,747
Southern California									
San Bernardino3/	--	--	--	--	--	--	--	--	--
All areas	6,549,424	5,416,606	1,133,151	5,076,670	4,455,631	621,372	1,472,754	960,975	511,779

1/ [illegible]

2/ [illegible]

3/ [illegible]

Table 32—Production and disposition of wood residues by sawmills

(Tons, dry

Resource area and county	All types						
	Total	Total used[1]	Pulp	Board	Fuel	Other	Unused
North Coast							
Del Norte	151,277	133,905	106,595	8,103	17,317	1,890	17,372
Humboldt	1,167,669	1,015,648	618,211	83,278	266,340	47,819	152,021
Mendocino	554,777	447,900	161,926	117,513	78,194	90,267	106,877
Sonoma	140,618	133,073	6,140	81,775	4,800	40,358	7,545
Total	2,014,341	1,730,526	892,872	290,669	366,651	180,334	283,815
Central Coast							
Monterey and Santa Cruz[3]	28,818	28,818	--	--	158	28,660	--
Northern Interior							
Lassen and Modoc[3]	191,377	160,416	70,040	13,779	76,597	--	30,961
Shasta	371,893	299,320	124,965	15,926	158,429	--	72,573
Siskiyou	341,490	335,601	182,655	4,526	148,259	161	5,889
Trinity	177,523	150,235	95,922	--	54,313	--	27,288
Total	1,082,283	945,572	473,582	34,231	437,598	161	136,711
Sacramento							
Butte	120,686	94,868	65,610	--	28,922	336	25,818
El Dorado	440,258	440,112	222,331	84,126	121,803	11,852	146
Glenn and Tehama[3]	224,373	216,561	116,356	12,792	87,413	--	7,812
Placer and Nevada[3]	204,778	169,199	76,606	--	44,186	48,407	35,579
Plumas and Sierra[3]	236,784	214,464	29,425	50,585	120,607	13,847	22,320
Yuba	125,873	103,571	64,709	--	37,564	1,298	22,302
Total	1,352,752	1,238,775	575,037	147,503	440,495	75,740	113,977
San Joaquin							
Calaveras and Amador[3]	133,093	101,076	64,379	22,614	8,127	5,956	32,017
Fresno and Madera[3]	161,735	135,573	67,294	43,393	8,805	16,081	26,162
Tulare and Kern[4]	174,039	145,742	61,448	43,408	15,199	25,687	28,297
Tuolumne	129,609	129,609	66,816	8,220	43,814	10,759	--
Total	598,476	512,000	259,937	117,635	75,945	58,483	86,476
Southern California							
San Bernardino[4]	--	--	--	--	--	--	—
All Areas	5,076,670	4,455,691	2,201,428	590,038	1,320,847	343,378	620,979

See footnotes at end of table.

by type of residue, use, resource area, and county, California, 1976

weight)

Shavings						
Total	Total used2/	Pulp	Board	Fuel	Other	Unused
11,664	11,664	558	6,745	4,361	--	--
135,663	121,082	1,544	68,894	47,151	3,493	14,581
74,598	67,532	--	37,638	21,104	8,790	7,066
20,498	18,983	--	6,417	--	12,566	1,515
242,423	219,261	2,102	119,694	72,616	24,849	23,162
2,408	2,408	--	--	--	2,408	--
36,073	32,236	--	13,560	18,676	--	3,837
59,790	59,169	--	13,622	45,547	--	621
53,474	53,474	7,518	4,526	41,430	--	--
27,932	23,090	711	--	22,379	--	4,842
177,269	167,969	8,229	31,708	128,032	--	9,300
19,632	19,632	--	--	19,602	30	--
89,467	89,467	--	84,126	2,418	2,923	--
40,370	40,370	--	12,792	27,578	--	--
27,571	23,601	--	--	18,102	5,499	3,970
38,362	38,362	--	9,863	14,652	13,847	--
22,419	21,158	--	--	21,158	--	1,261
237,821	232,590	--	106,781	103,510	22,299	5,231
13,605	13,605	--	13,605	--	--	--
11,943	11,943	--	5,075	--	6,868	--
32,064	31,135	--	11,098	6,374	13,663	929
10,274	10,274	--	8,220	--	2,054	--
67,886	66,957	--	37,998	6,374	22,585	929
--	--	--	--	--	--	--
727,807	689,185	10,331	296,181	310,532	72,141	38,622

Table 32—Production and disposition of wood residues by sawmills

(Tons, dry

Resource area and county	Sawdust						
	Total	Total used[2]	Pulp	Board	Fuel	Other	Unused
North Coast							
Del Norte	38,875	24,530	9,792	1,358	11,490	1,890	14,345
Humboldt	295,215	195,241	17,313	4,967	172,961	--	99,974
Mendocino	135,391	82,603	--	27,810	40,009	14,784	52,788
Sonoma	34,161	30,795	--	7,022	--	23,773	3,366
Total	503,642	333,169	27,105	41,157	224,460	40,447	170,473
Central Coast							
Monterey and Santa Cruz[3]	6,726	6,726	--	--	37	6,689	--
Northern Interior							
Lassen and Modoc[3]	52,506	42,998	--	219	42,779	--	9,508
Shasta	101,632	65,932	--	--	65,932	--	35,700
Siskiyou	94,597	92,095	--	--	91,934	161	2,502
Trinity	50,859	28,413	--	--	28,413	--	22,446
Total	299,594	229,438	--	219	229,058	161	70,156
Sacramento							
Butte	33,454	7,636	--	--	7,543	93	25,818
El Dorado	116,500	116,354	--	--	116,354	--	146
Glenn and Tehama[3]	61,843	54,031	--	--	54,031	--	7,812
Placer and Nevada[3]	59,720	28,111	--	--	26,084	2,027	31,609
Plumas and Sierra[3]	67,539	61,085	--	--	61,085	--	6,454
Yuba	34,048	13,058	--	--	11,811	1,247	20,990
Total	373,104	280,275	--	--	276,908	3,367	92,829
San Joaquin							
Calaveras and Amador[3]	37,091	14,083	--	--	8,127	5,956	23,008
Fresno and Madera[3]	48,252	37,694	--	19,809	8,672	9,213	10,558
Tulare and Kern[4]	47,766	29,932	--	15,315	8,761	5,856	17,834
Tuolumne	40,044	40,044	--	--	31,339	8,705	--
Total	173,153	121,753	--	35,124	56,899	29,730	51,400
Southern California							
San Bernardino[4]	--	--	--	--	--	--	--
All Areas	1,356,219	971,361	27,105	76,500	787,362	80,394	384,858

---

[1] Not necessarily used in the resource area in which produced.

[2] Slabs, edging, trim, and spur ends.

[3] Combined to avoid disclosure.

[4] Tulare, Kern, and San Bernardino combined to avoid disclosure.

by type of residue, use, resource area, and county, California, 1976 –Continued

weight)

Coarse2/						
Total	Total used1/	Pulp	Board	Fuel	Other	Unused
100,738	97,711	96,245	--	1,466	--	3,027
736,791	699,325	599,354	9,417	46,228	44,326	37,466
344,788	297,765	161,926	52,065	17,081	66,693	47,023
85,959	83,295	6,140	68,336	4,800	4,019	2,664
1,268,276	1,178,096	863,665	129,818	69,575	115,038	90,180
19,684	19,684	--	--	121	19,563	--
102,798	85,182	70,040	--	15,142	--	17,616
210,471	174,219	124,965	2,304	46,950	--	36,252
193,419	190,032	175,137	--	14,895	--	3,387
98,732	98,732	95,211	--	3,521	--	--
605,420	548,165	465,353	2,304	80,508	--	57,255
67,600	67,600	65,610	--	1,777	213	--
234,291	234,291	222,331	--	3,031	8,929	--
122,160	122,160	116,356	--	5,804	--	--
117,487	117,487	76,606	--	--	40,881	--
130,883	115,017	29,425	40,722	44,870	--	15,866
69,406	69,355	64,709	--	4,595	51	51
741,827	725,910	575,037	40,722	60,077	50,074	15,917
82,397	73,388	64,379	9,009	--	--	9,009
101,540	85,936	67,294	18,509	133	--	15,604
94,209	84,675	61,448	16,995	64	6,168	9,534
79,291	79,291	66,816	--	12,475	--	--
357,437	323,290	259,937	44,513	12,672	6,168	34,147
--	--	--	--	--	--	--
2,992,644	2,795,145	2,163,992	217,357	222,953	190,843	197,499

Table 33—Production and disposition of bark residues by sawmills by use, resource area, and county, California, 1976

(Tons, dry weight)

Resource area and county	All bark	Used[1]					Unused
		Total	Pulp	Board	Fuel	Miscellaneous	
North Coast							
Del Norte	46,366	7,807	--	--	7,807	--	38,559
Humboldt	344,249	173,011	--	--	173,011	--	171,238
Mendocino	150,347	36,364	--	--	32,008	4,356	113,983
Sonoma	39,943	17,176	--	--	--	17,176	22,767
Total	580,905	234,358	--	--	212,826	21,532	346,547
Central Coast							
Monterey and Santa Cruz[2]	8,583	8,349	--	--	44	8,305	234
Northern Interior							
Lassen and Modoc[2]	53,722	43,699	--	--	17,479	26,220	10,023
Shasta	106,769	83,164	--	--	73,862	9,302	23,605
Siskiyou	99,293	96,728	--	--	90,976	5,752	2,565
Trinity	52,179	19,783	--	--	--	19,783	32,396
Total	311,963	243,374	--	--	182,317	61,057	68,589
Sacramento							
Butte	34,909	34,909	--	--	8,417	26,492	--
El Dorado	120,385	109,823	--	--	5,394	104,429	10,562
Glenn and Tehama[2]	63,173	53,921	--	--	5,871	48,050	9,252
Placer and Nevada[2]	60,887	51,630	--	--	14,841	36,789	9,257
Plumas and Sierra[2]	69,162	50,739	--	--	21,556	29,183	18,423
Yuba	35,746	11,578	--	--	11,550	28	24,168
Total	384,262	312,600	--	--	67,629	244,971	71,662
San Joaquin							
Calaveras and Amador[2]	40,769	34,919	--	--	9,814	25,105	5,850
Fresno and Madera[2]	55,190	37,633	--	--	67	37,566	17,557
Tulare and Kern[3]	49,105	47,765	--	--	2,121	45,644	1,340
Tuolumne	41,977	41,977	--	--	27,705	14,272	--
Total	187,041	162,294	--	--	39,707	122,587	24,747
Southern California							
San Bernardino[3]	--	--	--	--	--	--	--
All Areas	1,472,754	960,975	--	--	502,523	458,452	511,779

[1] Not necessarily used in the resource area in which produced.

[2] Combined to avoid disclosure.

[3] Tulare, Kern, and San Bernardino combined to avoid disclosure.

Table 34—Lumber production by sawmills by degree of manufacture, resource area, and mill-size class, California, 1976

(Thousand board feet, lumber tally)

Resource area and mill-size class[1/]	Green	Kiln-dried	Air-dried	Total	Rough	Surfaced
North Coast						
D and C[2/]	88,204	11,415	13,260	112,879	64,090	48,789
B	227,874	30,894	16,146	274,914	111,434	163,480
A	1,326,431	266,341	36,713	1,629,485	502,489	1,126,996
Total	1,642,509	308,650	66,119	2,017,278	678,013	1,339,265
Central Coast						
D, C, and B[2/]	27,951	--	879	28,830	13,920	14,910
Northern Interior						
D	10,918	--	65	10,983	7,096	3,887
C	13,700	--	6,602	20,302	14,631	5,671
B	71,961	128,393	10,241	210,595	48,951	161,644
A	210,985	580,967	57,638	849,590	140,435	709,155
Total	307,564	709,360	74,546	1,091,470	211,113	880,357
Sacramento						
D	2,525	6,400	195	9,120	2,530	6,590
C	23,571	73,756	1,621	98,948	17,165	81,783
B	167,540	276,331	24,150	468,021	137,290	330,731
A	58,055	410,463	7,738	476,256	77,236	399,020
Total	251,691	766,950	33,704	1,052,345	234,221	818,124
San Joaquin						
D	230	--	100	330	320	10
C[3/]	17,293	35,605	10,350	63,248	35,140	28,108
B	132,133	80,654	4,943	217,730	127,174	90,556
A	103,166	237,739	30,585	371,490	153,278	218,212
Total	252,822	353,998	45,978	652,798	315,912	336,886
Southern California						
C[3/]	--	--	--	--	--	--
All Areas						
D	13,673	6,400	360	20,433	9,946	10,487
C	142,768	120,776	31,833	295,377	131,026	164,351
B	627,459	516,272	56,359	1,200,090	438,769	761,321
A	1,698,637	1,495,510	132,674	3,326,821	873,438	2,453,383
Total	2,482,537	2,138,958	221,226	4,842,721	1,453,179	3,389,542

[1/] Mill-size classes are as follows: Class A mills = 120,000+ board-foot capacity per 8-hour shift, B = 80,000-119,999, C = 40,000-79,999, D = less than 40,000.

[2/] Combined to avoid disclosure.

[3/] San Joaquin and Southern California combined to avoid disclosure.

Table 35--Number of veneer and plywood mills by type of mill, resource area, and county, California, 1976

Resource area and county	All types	Veneer only	Layup only	Veneer and layup
North Coast				
Del Norte	3	3	--	--
Humboldt	7	3	--	4
Mendocino	1	--	--	1
Total	11	6	--	5
Northern Interior				
Shasta	2	1	--	1
Siskiyou	3	3	--	--
Total	5	4	--	1
Sacramento				
El Dorado	1	1	--	--
Nevada	1	1	--	--
Tehama	1	--	--	1
Total	3	2	--	1
San Joaquin				
Amador	1	--	--	1
Tuolumne	1	--	--	1
Total	2	--	--	2
All Areas	21	12	--	9

Table 36--Installed 8-hour capacity of veneer and plywood mills by type of mill, resource area, and county, California, 1976

(Thousand square feet, 3/8-inch basis)

Resource area and county	Veneer only	Veneer and layup	
		Veneer	Layup
North Coast			
Del Norte	825	--	--
Humboldt	415	935	715
Mendocino	--	120	142
Total	1,240	1,055	857
Northern Interior			
Shasta	170	150	80
Siskiyou	550	--	--
Total	720	150	80
Sacramento			
El Dorado	50	--	--
Nevada	30	--	--
Tehama	--	130	130
Total	80	130	130
San Joaquin			
Amador	--	200	150
Tuolumne	--	150	100
Total	--	350	250
All Areas	2,040	1,685	1,317

Table 37--Number of veneer and plywood mills by diameter limit of lathe and resource area, California, 1976

Resource area	Lathe log diameter limit							
	Layup only	20-29	30-39	40-49	50-59	60-69	70-79	80+
North Coast	--	--	--	--	--	3	2	6
Northern Interior	--	--	--	1	1	1	1	1
Sacramento	--	1	--	1	--	1	--	--
San Joaquin	--	--	--	--	--	1	--	1
All Areas	--	1	--	2	1	6	3	8

Table 38--Number of veneer and plywood mills by size of core produced and resource area, California, 1976

Resource area	Diameter of cores (inches)							
	3	4	5	6	7	8	9	10+
North Coast	--	1	1	1	3	--	2	3
Northern Interior	--	--	1	1	1	0	1	1
Sacramento	--	1	--	2	--	--	--	--
San Joaquin	--	--	--	1	1	--	--	--
All Areas	--	2	2	5	5	--	3	4

Table 39--Number of veneer and plywood mills having selected equipment, by resource area and county, California, 1976

Resource area and county	4-foot lathe	8-foot lathe	Slicer	Veneer chipper	Core chipper	Cold press	Hot press	Burner
North Coast								
Del Norte	1	3	--	2	2	--	--	2
Humboldt	1	7	2	7	4	1	4	3
Mendocino	--	1	--	1	--	--	1	--
Total	2	11	2	10	6	1	5	5
Northern Interior								
Shasta	1	2	--	2	1	--	1	--
Siskiyou	1	3	--	3	2	--	--	1
Total	2	5	--	5	3	--	1	1
Sacramento								
El Dorado	1	--	--	--	--	--	--	--
Nevada	1	--	1	--	1	--	--	--
Tehama	--	1	--	1	1	--	1	--
Total	2	1	1	1	2	--	1	--
San Joaquin								
Amador	--	1	--	1	1	--	1	1
Tuolumne	--	1	--	--	1	--	1	--
Total	--	2	--	1	2	--	2	1
All Areas	6	19	3	17	13	1	9	7

Table 40--Number of veneer and plywood mills by years of tenure of present mill ownership, resource area, and years at site, California, 1976

Resource area and years at site	All mills	Tenure of present mill ownership (years)				
		0-2	3-5	6-10	11-20	21+
North Coast						
6-10	3	--	1	2	--	--
11-20	3	--	2	--	1	--
21+	5	2	1	1	1	--
Total	11	2	4	3	2	--
Northern Interior						
6-10	1	--	--	1	--	--
11-20	1	--	--	1	--	--
21+	3	--	1	--	--	2
Total	5	--	1	2	--	2
Sacramento						
6-10	1	1	--	--	--	--
11-20	1	--	--	--	1	--
21+	1	--	--	--	1	--
Total	3	1	--	--	2	--
San Joaquin						
11-20	2	--	--	1	1	--
All Areas						
6-10	5	1	1	3	--	--
11-20	7	--	2	2	3	--
21+	9	2	2	1	2	2
Total	21	3	5	6	5	2

Table 41--Average number of operating days of veneer and plywood mills by type of of mill and resource area, California, 1976

Resource area	Veneer only	Veneer and layup
North Coast	197	264
Northern Interior	246	240
Sacramento	105	260
San Joaquin	--	229
All Areas	198	253

Table 42--Log consumption by veneer and plywood mills by type of material and resource area, California, 1976

(Thousand board feet, local scale)

Resource area	Total roundwood	Sound logs	Utility logs
North Coast	293,919	260,653	33,266
Northern Interior	149,861	139,326	10,535
Sacramento and San Joaquin[1]	94,896	94,896	--
All Areas	538,676	494,875	43,801

[1] Combined to avoid disclosure.

Table 43--Log consumption by veneer and plywood mills by timber age group and resource area, California, 1976

(Thousand board feet, local scale)

Resource area	All age groups	Old growth (100+ years)	Young growth (less than 100 years)
North Coast	293,919	243,015	50,904
Northern Interior	149,861	112,315	37,546
Sacramento and San Joaquin[1]	94,896	58,841	36,055
All Areas	538,676	414,171	124,505

[1] Combined to avoid disclosure.

Table 44--Log inventory changes, log consumption, and apparent log receipts by veneer and plywood mills by resource area, California, 1976

(Thousand board feet, local scale)

Resource area	Log inventory			1976 log consumption	Apparent 1976 log receipts
	January 1, 1976	December 31, 1976	Net change		
North Coast	40,900	44,383	3,483	293,919	297,402
Northern Interior	28,636	41,166	12,530	149,861	162,391
Sacramento and San Joaquin[1/]	42,970	64,641	21,671	94,896	116,567
All Areas	112,506	150,190	37,684	538,676	576,360

[1/] Combined to avoid disclosure.

Table 45—Log consumption by veneer and plywood mills by ownership class and resource area, California, 1976

(Thousand board feet, local scale)

Resource area	All owners	State	National Forest	Bureau of Land Management	Other public	Forest industry		Farmer and miscellaneous private
						Own wood supply	Other wood supply	
North Coast	293,919	2,334	37,096	--	13,692	157,616	58,150	25,031
Northern Interior	149,861	--	60,519	--	--	19,203	51,931	18,031
Sacramento and San Joaquin[1/]	94,896	--	55,254	--	--	35,253	--	4,389
All Areas	538,676	2,334	152,869	--	13,692	212,072	101,081	47,628

[1/] Combined to avoid disclosure.

Table 46—Dependency of veneer and plywood mills for logs

(Number

Resource area	National Forest				State				Bureau of Land Management			
	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100
North Coast	6	3	1	1	9	2	--	--	11	--	--	--
Northern Interior	--	3	1	1	5	--	--	--	5	--	--	--
Sacramento	1	--	2	--	3	--	--	--	3	--	--	--
San Joaquin	--	--	1	1	2	--	--	--	2	--	--	--
All Areas	7	6	5	3	19	2	--	--	21	--	--	--

by ownership origin and resource area, California, 1976

of mills]

		ndustry									
	: supply				Other supply				rmer and miscellaneous private		
0	1-32	33-66	[illegible]	[illegible]	1-32	33-66	67-100		1-32	33-66	67-100
9		1	5	1	—	1	1			—	1
5	1	1	—	2	1	—		2	1		
3	—		1	3	—	—	—	2	1	--	
2	1	1	—		—	—	—	1	1	—	—
19	3	5	6	16	1	3			8	2	1

Table 47—Log consumption by veneer and plywood mills by species, resource area, and type of material, California, 1976

(Thousand board feet, local scale)

Resource area and type of material	All species	Douglas-fir	Hemlock	True firs	Redwood	Ponderosa pine	Sugar pine	Incense-cedar	Other softwoods	Hardwoods
North Coast										
Sound	260,653	209,201	6,354	6,775	32,281	2,617	--	--	3,225	200
Utility	33,266	32,322	404	--	490	--	--	--	50	--
Total	293,919	241,523	6,758	6,775	32,771	2,617	--	--	3,275	200
Northern Interior										
Sound	139,326	51,761	--	55,417	--	24,493	4,500	--	3,155	--
Utility	10,535	4,918	--	1,574	--	2,207	875	--	961	--
Total	149,861	56,679	--	56,991	--	26,700	5,375	--	4,116	--
Sacramento and San Joaquin[1]										
Sound	94,896	7,734	--	78,872	--	8,290	--	--	--	--
Utility	--	--	--	--	--	--	--	--	--	--
Total	94,896	7,734	--	78,872	--	8,290	--	--	--	--
All Areas										
Sound	494,875	268,696	6,354	141,064	32,281	35,400	4,500	--	6,380	200
Utility	43,801	37,240	404	1,574	490	2,207	875	--	1,011	--
Total	538,676	305,936	6,758	142,638	32,771	37,607	5,375	--	7,391	200

[1] Combined to avoid disclosure.

Table 48—Production and disposition of wood and bark residues by veneer and plywood mills, by resource area, California, 1976

(Tons, dry weight)

Resource area	All residues			Wood residue			Bark residue		
	Total	Used[1]	Unused	Total	Used[1]	Unused	Total	Used[1]	Unused
North Coast	421,110	371,059	50,051	325,858	321,349	4,509	95,252	49,710	45,542
Northern Interior	189,228	173,391	15,837	138,343	135,268	3,075	50,885	38,123	12,762
Sacramento and San Joaquin[2]	135,311	122,982	12,329	105,667	94,526	11,141	29,644	28,456	1,188
All Areas	745,649	667,432	78,217	569,868	551,143	18,725	175,781	116,289	59,492

[1] Not necessarily used in the resource area in which produced.

[2] Combined to avoid disclosure.

Table 49—Production and disposition of wood residue by veneer and plywood mills by type of residue, use, and resource area, California, 1976

(Tons, dry weight)

Resource area	All types						Fine[3]		
	Total	Total used[1]	Pulp and board	Fuel	Miscellaneous	Unused	Total	Total used[1]	Pulp and board
North Coast	325,858	321,349	179,202	104,573	37,574	4,509	9,339	8,689	--
Northern Interior	138,343	135,268	99,337	11,528	24,403	3,075	1,174	1,174	--
Sacramento and San Joaquin[4]	105,667	94,526	80,332	4,627	9,567	11,141	4,400	4,400	1,473
All Areas	569,868	551,143	358,871	120,728	71,544	18,725	14,913	14,263	1,473

Resource area	Fine[3]			Coarse and medium[2]					
	Fuel	Miscellaneous	Unused	Total	Total used[1]	Pulp and board	Fuel	Miscellaneous	Unused
North Coast	8,689	--	650	316,519	312,660	179,202	95,884	37,574	3,859
Northern Interior	--	1,174	--	137,169	134,094	99,337	11,528	23,229	3,075
Sacramento and San Joaquin[4]	2,927	--	--	101,267	90,126	78,859	1,700	9,567	11,141
All Areas	11,616	1,174	650	554,955	536,880	357,398	109,112	70,370	18,075

[1] Not necessarily used in the resource area in which produced.

[2] Includes log trim, cores, veneer clippings, rejected veneer, roundup, and spur trim.

[3] Includes sawdust and sander dust.

[4] Combined to avoid disclosure.

Table 50--Production and disposition of bark residues by veneer and plywood mills by use and resource area, California, 1976

(Tons, dry weight)

Resource area	All bark	Used[1]				Unused
		Total	Pulp and board	Fuel	Other	
North Coast	95,252	49,710	--	49,710	--	45,542
Northern Interior	50,885	38,123	--	28,630	9,493	12,762
Sacramento and San Joaquin[2]	29,644	28,456	--	8,667	19,789	1,188
All Areas	175,781	116,289	--	87,007	29,282	59,492

[1] Not necessarily used in the resource area in which produced.

[2] Combined to avoid disclosure.

Table 51--Number of pulpmills and board mills by type of operation, resource area, and county, California, 1976

Resource area and county	All mills	Type of pulpmill				Type of board mill	
		Sulfite	Sulfate	Groundwood[1]	Semichemical	Hardboard	Particleboard
North Coast							
Del Norte	1	--	--	--	--	--	1
Humboldt	3	--	2	--	--	--	1
Mendocino	2	--	--	--	--	1	1
Total	6	--	2	--	--	1	3
Central Coast							
Contra Costa	3	--	1	2	--	--	--
Northern Interior							
Shasta	1	--	1	--	--	--	--
Sacramento							
Butte	1	--	--	--	--	1	--
Placer	1	--	--	--	--	--	1
Plumas	1	--	--	--	--	--	1
Tehama	1	--	--	1	--	--	--
Total	4	--	--	1	--	1	[illegible]
San Joaquin							
Amador	1	--	--	--	--	--	1
Madera	1	--	--	--	--	--	1
Total	2	--	--	--	--	--	[illegible]
Southern California							
San Bernardino	1	--	--	--	--	--	1
All Areas	17	--	4	3	--	[illegible]	[illegible]

[1] Includes one roofing-felt mill.

Table 52--Installed capacity of pulpmills and board mills by type of mill, resource area, and county, California, 1976

Resource area and county	Type of pulpmill			Type of board mill	
	Sulfate	Groundwood[1]	Semichemical	Hardboard	Particleboard
	24 hr., Tons, dry weight			Annual, million square feet	
				(1/8-inch basis)	(3/4-inch basis)
North Coast					
Del Norte	--	--	--	--	26
Humboldt	1,140	--	--	--	172
Mendocino	--	--	--	355	215
Total	1,140	--	--	355	413
Central Coast					
Contra Costa	850	122	--	--	--
Northern Interior					
Shasta	170	--	--	--	--
Sacramento					
Butte	--	--	--	126	--
Placer	--	--	--	--	60
Plumas	--	--	--	--	28
Tehama	--	80	--	--	--
Total	--	80	--	126	88
San Joaquin					
Amador	--	--	--	--	95
Tulare	--	--	--	--	32
Total	--	--	--	--	127
Southern California					
San Bernardino	--	--	--	--	58
All Areas	2,160	202	--	481	686

[1] Includes one roofing-felt mill.

Table 53--Number of pulpmills and board mills by years of tenure of present ownership, type of mill, and years at site, California, 1976

Mill type and years at site	All mills	Tenure of present ownership (years)			
		0-2	3-5	11-20	21+
Sulfate					
11-20	3	--	2	1	--
21+	1	--	--	--	1
Total	4	--	2	1	1
Groundwood[1/]					
11-20	1	--	--	1	--
21+	2	--	--	--	2
Total	3	--	--	1	2
Hardboard					
0- 2	1	1	--	--	--
21+	1	--	--	--	1
Total	2	1	--	--	1
Particleboard					
0- 2	1	1	--	--	--
3- 5	3	--	3	--	--
11-20	4	1	--	3	--
Total	8	2	3	3	--
All mills					
0- 2	2	2	--	--	--
3- 5	3	--	3	--	--
11-20	8	1	2	5	--
21+	4	--	--	--	4
Total	17	3	5	5	4

[1/] Includes one roofing-felt mill.

Table 54--Average number of operating days of pulpmills and board mills by resource area, California, 1976

Resource area	Pulp	Board
North Coast	300	307
Central Coast	340	--
Northern Interior	350	--
Sacramento	270	234
San Joaquin	--	282
Southern California	--	132
All Areas	320	275

Table 55--Wood consumption by pulpmills and board mills by type of material consumed and resource area, California, 1976

Resource area	Roundwood			Other				
	Total	Sound logs	Utility logs	Total	Chips		Sawdust	Shavings
					From mill residue	From other sources		
	Thousand board feet, local scale			Tons, dry weight				
North Coast	--	--	--	1,276,036	873,426	7,236	126,214	269,160
Central Coast	2,700	2,700	--	510,190	510,190	--	--	--
Northern Interior and Sacramento[1]	--	--	--	285,086	185,900	--	22,786	76,400
San Joaquin and Southern California[1]	--	--	--	262,168	56,602	--	8,200	197,366
All Areas	2,700	2,700	--	2,333,480	1,626,118	7,236	157,200	542,926

[1] Combined to avoid disclosure.

[illegible]

(Thousand board feet, local scale)

Resource area	All age groups	Old growth (100+ years)	Young growth (less than 100 years)
Central Coast	2,700	2,700	--
All Areas	2,700	2,700	--

Table 57--Log consumption by pulpmills and l [illegible] ership class and resource area, California, [illegible]

(Thousand board feet, local scale)

Resource area	All owners	State	National Forest	Forest industry		Farmer and miscellaneous private
				Own wood supply	Other wood supply	
Central Coast	2,700	--	--	1,350	1,350	--
All Areas	2,700	--	--	1,350	1,350	--

Table 58--Log consumption by pulpmills and board mills by species, resource area, and type of material, California, 1976

(Thousand board feet, local scale)

Resource area and type of material	All species	Douglas-fir	Hemlock	True firs	Redwood
Central Coast					
Sound	2,700	1,755	--	945	--
Utility	--	--	--	--	--
Total	2,700	1,755	--	945	--
All Areas					
Sound	2,700	1,755	--	945	--
Utility	--	--	--	--	--
Total	2,700	1,755	--	945	--

Resource area and type of material	Ponderosa pine	Sugar pine	Incense-cedar	Other softwoods	Hardwoods
Central Coast					
Sound	--	--	--	--	--
Utility	--	--	--	--	--
Total	--	--	--	--	--
All Areas					
Sound	--	--	--	--	--
Utility	--	--	--	--	--
Total	--	--	--	--	--

Table 59--Pulpmill and board mill consumption of mill residues and chips from other sources, by State of origin, resource area, and type of material, California, 1976

(Tons, dry weight)

Resource area and type of material	Total volume	California	Oregon
North Coast			
Chip residue	873,426	873,426	--
Chips, other sources	7,236	7,236	--
Sawdust and shavings	395,374	394,450	924
Total	1,276,036	1,275,112	924
Central Coast			
Chip residue	510,190	510,108	82
Chips, other sources	--	--	--
Sawdust and shavings	--	--	--
Total	510,190	510,108	82
Northern Interior and Sacramento[1]			
Chip residue	185,900	185,900	--
Chips, other sources	--	--	--
Sawdust and shavings	99,186	99,186	--
Total	285,086	285,086	--
San Joaquin and Southern California[1]			
Chip residue	56,602	56,602	--
Chips, other sources	--	--	--
Sawdust and shavings	205,566	205,566	--
Total	262,168	262,168	--
All Areas			
Chip residue	1,626,118	1,626,036	82
Chips, other sources	7,236	7,236	--
Sawdust and shavings	700,126	699,202	924
Total	2,333,480	2,332,474	1,006

[1] Combined to avoid disclosure.

Table 60--Number of "other industry" mills by type of industry, resource area, and county, California, 1976

Resource area and county	All types	Shake and shingle	Export	Pole, post, and piling
North Coast				
Humboldt	9	3	6	--
Mendocino	4	4	--	--
Total	13	7	6	--
Central Coast				
Solano	1	--	--	1
Northern Interior				
Siskiyou	1	--	--	1
Sacramento				
Butte	1	--	--	1
Sacramento	1	--	1	--
Total	2	--	1	1
San Joaquin				
Madera	1	--	--	1
San Joaquin	1	--	--	1
Total	2	--	--	2
Southern California				
Los Angeles	1	--	--	1
All Areas	20	7	7	6

Table 61--Installed capacity of "other industry" mills by resource area and county, California, 1976

Resource area and county	Shake and shingle (8-hour shift)	Post, pole, and piling (yearly)
	Squares	Thousand board feet, local scale
North Coast		
Humboldt	80	--
Mendocino	58	--
Total	138	--
Central Coast		
Solano	--	3,800
Northern Interior		
Siskiyou	--	380
Sacramento		
Butte	--	11,475
San Joaquin		
Madera	--	4,500
San Joaquin	--	1,688
Total	--	6,188
Southern California		
Los Angeles	--	18,720
All Areas	138	40,563

Table 62--Number of "other industry" mills with selected equipment, by resource area and county, California, 1976

Resource area and county	Chipper	Barker	Burner
North Coast			
Humboldt	--	--	1
Mendocino	--	--	--
Total	--	--	1
Central Coast			
Solano	--	--	--
Northern Interior			
Siskiyou	--	--	--
Sacramento			
Butte	--	1	1
San Joaquin			
Madera	--	1	--
San Joaquin	--	1	--
Total	--	2	--
Southern California			
Los Angeles	--	--	--
All Areas	--	3	2

Table 63--Number of "other industry" mills by years of tenure of present ownership, type of mill, and years at site, California, 1976

Type of mill and years at site	All mills	Tenure of present mill ownership (years)				
		0-2	3-5	6-10	11-20	21+
Shake and shingle						
0- 2	3	3	--	--	--	--
3- 5	1	1	--	--	--	--
6-10	1	--	--	1	--	--
11-20	2	--	--	--	2	--
Total	7	4	--	1	2	--
Post, pole, and piling						
3- 5	1	--	1	--	--	--
11-20	1	--	--	--	1	--
21+	4	--	--	--	1	3
Total	6	--	1	--	2	3
All Mills						
0- 2	3	3	--	--	--	--
3- 5	2	1	1	--	--	--
6-10	1	--	--	1	--	--
11-20	3	--	--	--	3	--
21+	4	--	--	--	1	3
Total	13	4	1	1	4	3

Table 64--Average number of operating days per year of "other industry" mills by type of mill and resource area, California, 1976

Resource area	Shake and shingle	Post, pole, and piling
North Coast	167	--
Central Coast	--	325
Northern Interior	--	300
Sacramento	--	250
San Joaquin	--	204
Southern California	--	300
All Areas	167	264

Table 65--Log consumption by "other industry" mills by type of material and type of mill, California, 1976

(Thousand board feet, local scale)

Type of mill	All types	Sound logs	Utility logs	Other[1]
Shake and shingle	3,455	895	2,560	--
Export	97,695	97,695	--	--
Post, pole, and piling	9,821	9,321	500	--
Total	110,971	107,911	3,060	--

[1] Lumber, cross ties, and miscellaneous other products.

[illegible]

(Thousand board feet, local scale)

Type of mill	All age groups	Old growth (100+ years)	Young growth (less than 100 years)
Shake and shingle	3,455	3,455	--
Export	97,695	28,956	68,739
Post, pole, and piling	9,821	716	9,105
Total	110,971	33,127	77,844

Table 67--Log consumption by "other industry" mills by ownership class and type of mill, California, 1976

(Thousand board feet, local scale)

Type of mill	All owners	National Forest	State	Bureau of Land Management	Forest industry		Farmer and miscellaneous private
					Own wood supply	Other wood supply	
Shake and shingle	3,455	--	1,512	--	--	1,583	360
Export	97,695	5,240	--	--	--	66,351	26,104
Post, pole, and piling	9,821	879	--	303	1,859	[illegible]	3,895
Total	110,971	6,119	1,512	303	1,859	70,819	30,359

Table 68—Dependency of "other industry" mills for logs by

(Number

Resource area and type of mill	National Forest				State				Bureau of Land Management			
	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100
North Coast												
Shake and shingle	7	--	--	--	5	--	1	1	7	--	--	--
Export		[illegible]	--	--	6	--	--	--	6	--	--	--
Total	9	[illegible]	--	--	11	--	1	1	13	--	--	--
Central Coast												
Post, pole, and piling	--	1	--	--	1	--	--	--	--	1	--	--
Northern Interior												
Post, pole, and piling	--	[illegible]	--	--	1	--	--	--	--	1	--	--
Sacramento												
Export		--	--	--	1	--	--	--	1	--	--	--
Post, pole, and piling	--	[illegible]	--	--	1	--	--	--	--	1	--	--
Total	--	1	--	--	2	--	--	--	1	1	--	--
San Joaquin												
Post, pole, and piling		--	--	--	1	--	--	--	2	--	--	--
Southern California												
Post, pole, and piling	--	[illegible]	--	--	1	--	--	--	1	--	--	--
All areas												
Shake and shingle	[illegible]	--	--	--	[illegible]	--	1	1	7	--	--	--
Export	[illegible]	[illegible]	--	--	[illegible]	--	--	--	7	--	--	--
Post, pole, and piling	[illegible]	[illegible]	--	--	[illegible]	--	--	--	3	3	--	--
Total	[illegible]	[illegible]	--	--	[illegible]	--	1	1	17	3	--	--

ownership origin, resource area, and type of mill, California, 1976

of mills)

Other public				Forest industry								Farmer and miscellaneous private			
				Own wood supply				Other wood supply							
Dependency (percent)															
0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100	0	1-32	33-66	67-100
7	--	--	--	7	--	--	--	3	1	1	2	5	1	--	1
6	--	--	--	6	--	--	--	1	--	3	2	2	3	--	1
13	--	--	--	13	--	--	--	4	1	4	4	7	4	--	2
1	--	--	--	1	--	--	--	--	--	1	--	--	1	--	--
1	--	--	--	--	--	1	--	--	1	--	--	1	--	--	--
1	--	--	--	1	--	--	--	--	--	1	--	--	1	--	--
1	--	--	--	1	--	--	--	1	--	--	--	--	--	--	1
2	--	--	--	2	--	--	--	1	--	1	--	--	1	--	1
2	--	--	--	1	--	1	--	1	--	1	--	--	--	2	--
1	--	--	--	--	--	1	--	--	1	--	--	1	--	--	--
7	--	--	--	7	--	--	--	3	1	1	2	5	1	--	1
7	--	--	--	7	--	--	--	1	--	4	2	2	4	--	1
6	--	--	--	3	--	3	--	2	2	2	--	2	1	2	1
20	--	--	--	17	--	3	--	6	3	7	4	9	6	2	3

Table 69—Log consumption by "other industry" mills by species, type of mill, and type of material, California, 1976

(Thousand board feet, local scale)

Type of mill and material	All species	Douglas-fir	Hemlock	True firs	Redwood	Ponderosa pine	Sugar pine	Incense-cedar	Other softwoods	Hardwoods
Shake and shingle										
Sound	895	--	--	--	--	--	--	--	895	--
Utility	2,560	--	--	--	--	--	--	--	2,560	--
Total	3,455	--	--	--	--	--	--	--	3,455	--
Export										
Sound	97,695	45,282	36,971	4,895	--	8,480	--	970	1,097	--
Utility	--	--	--	--	--	--	--	--	--	--
Total	97,695	45,282	36,971	4,895	--	8,480	--	970	1,097	--
Post, pole, and piling										
Sound	9,321	5,137	--	130	--	4,035	--	--	19	--
Utility	500	400	--	50	--	50	--	--	--	--
Total	9,821	5,537	--	180	--	4,085	--	--	19	--
All Mills										
Sound	107,911	50,419	36,971	5,025	--	12,515	--	970	2,011	--
Utility	3,060	400	--	50	--	50	--	--	2,560	--
Total	110,971	50,819	36,971	5,075	--	12,565	--	970	4,571	--

✿ U S GOVERNMENT PRINTING OFFICE 1978—798-0

Table 70--Production and disposition of wood and bark residues by shake and shingle mills, California, 1976

(Tons, dry weight)

Type of residue	Total	Used				Unused
		Total	Pulp and board	Fuel	Other	
Wood	902	506	--	118	388	396
Bark	561	8	--	--	8	553
All residue	1,463	514	--	118	396	949

Table 71--Product output of "other industries" by type of mill, California, 1976

Production	Shake and shingle	Shipments		
		Export	Post, pole, and piling	
			Treated	Untreated
	Squares	- - - Thousand board feet, local scale - - -		
State total	21,070	97,695	13,949	--

Hiserote, Bruce A., and James O. Howard.
1978. California's forest industry, 1976. USDA
For. Serv. Resour. Bull. PNW-80, 95 p., illus.
Pacific Northwest Forest and Range Experiment
Station, Portland, Oregon.

This report presents the findings of a 100-percent canvas of the primary forest products industry in California for 1976. Tabular presentation includes characteristics of the industry log consumption and disposition of mill residues. Accompanying the tables is a descriptive analysis of conditions and trends in the industry.

KEYWORDS: Forest products industries, wood utilization, wood waste utilization, mill operation/products, California.

Hiserote, Bruce A., and James O. Howard.
1978. California's forest industry, 1976. USDA
For. Serv. Resour. Bull. PNW-80, 95 p., illus.
Pacific Northwest Forest and Range Experiment
Station, Portland, Oregon.

This report presents the findings of a 100-percent canvas of the primary forest products industry in California for 1976. Tabular presentation includes characteristics of the industry log consumption and disposition of mill residues. Accompanying the tables is a descriptive analysis of conditions and trends in the industry.

KEYWORDS: Forest products industries, wood utilization, wood waste utilization, mill operation/products, California.

Hiserote, Bruce A., and James O. Howard.
1978. California's forest industry, 1976. USDA
For. Serv. Resour. Bull. PNW-80, 95 p., illus.
Pacific Northwest Forest and Range Experiment
Station, Portland, Oregon.

This report presents the findings of a 100-percent canvas of the primary forest products industry in California for 1976. Tabular presentation includes characteristics of the industry log consumption and disposition of mill residues. Accompanying the tables is a descriptive analysis of conditions and trends in the industry.

KEYWORDS: Forest products industries, wood utilization, wood waste utilization, mill operation/products, California.

Hiserote, Bruce A., and James O. Howard.
1978. California's forest industry, 1976. USDA
For. Serv. Resour. Bull. PNW-80, 95 p., illus.
Pacific Northwest Forest and Range Experiment
Station, Portland, Oregon.

This report presents the findings of a 100-percent canvas of the primary forest products industry in California for 1976. Tabular presentation includes characteristics of the industry log consumption and disposition of mill residues. Accompanying the tables is a descriptive analysis of conditions and trends in the industry.

KEYWORDS: Forest products industries, wood utilization, wood waste utilization, mill operation/products, California.

The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Developing and evaluating alternative methods and levels of resource management.
3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research are made available promptly. Project headquarters are at:

Fairbanks, Alaska
Juneau, Alaska
Bend, Oregon
Corvallis, Oregon
La Grande, Oregon
Portland, Oregon
Olympia, Washington
Seattle, Washington
Wenatchee, Washington

*Mailing address: Pacific Northwest Forest and Range
Experiment Station
P.O. Box 3141
Portland, Oregon 97208*

77

The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

The U.S. Department of Agriculture is an Equal Opportunity Employer. Applicants for all Department programs will be given equal consideration without regard to race, color, sex or national origin.